

## SUSTAINABILITY BY DESIGN IN TEXTILE PRODUCTS AND FASHION

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**Abstract.** Sustainability is to deliver everything we need to live, without disturbing the natural equilibrium, to future generations and to produce and sustain them in ways that they can benefit. Sensitivity to the environment is essential in sustainability. Manifesto, take it from nature, give it back to nature, or reapply it. Natural return is the goal of sustainability to produce environmentally friendly products and to recreate less consuming society. We have to spend our consumption habits for a sustainable life, we must adopt slow fashion instead of fast fashion in order to reduce the most damage to the environment in the concept of fashion which is effective in every area of our life today. Fashion, on the other hand, is a concept that is connected to a much more design than any other period, and has become a phenomenon that shapes every stage of our life, every field. The ultimate in design is the design and production of much more product variety than we can consume. This kind of production damages the neighborhood too much and confronts future generations with a world that can not be experienced. For this reason, this article will talk about the importance of sustainability, its contribution to sustainability of design, and how sustainability can be achieved through design within textiles and fashion.

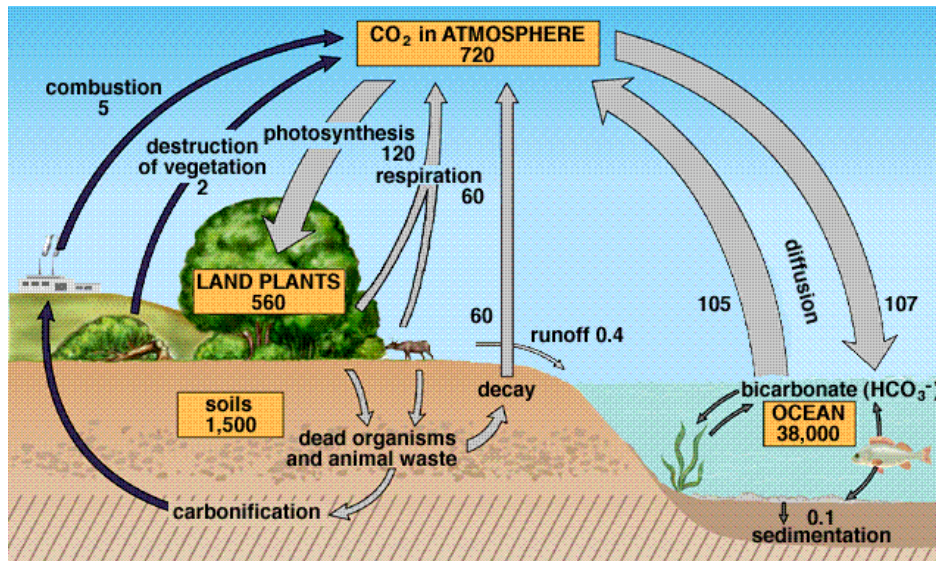
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### 1. Introduction

The main goal in sustainability is to leave a livable world to future generations, to rebalance the distorted biological, economic and social balances, to make as many natural return studies as possible, to manage resources properly, to organize and protect the ecological balance of the Earth. The sustainable word was first used in 1712 by the German scientist Hans Carl von Carlowitz in his book "Sylvicultura Oeconomica". It was developed in the 1970s to prevent damage to the environment and humanity and to combat climate change. In 1995, the United Nations established the Commission on Sustainable Development (CSD) to monitor international companies, governments and NGOs' work on the subject. Over time, sustainability became a global phenomenon and the concept of Global Sustainability was born at the "United Nations Conference on Environment and Development" held in Rio De Janerio between 3-14 June 1992. Sustainability today is not just a concept related to industrial production today. Sustainability is confronted by the ability to survive in a competitive production environment, to work in a world where resources are limited, to reduce environmental impacts, to reduce costs for sustainable production, and to sustain their assets by meeting customer expectations and concerns all areas including the service sector. The use of the concept of sustainability in the manufacturing sector is the climate change that is the result of the high carbon level in the atmosphere.



### Carbon Cycle

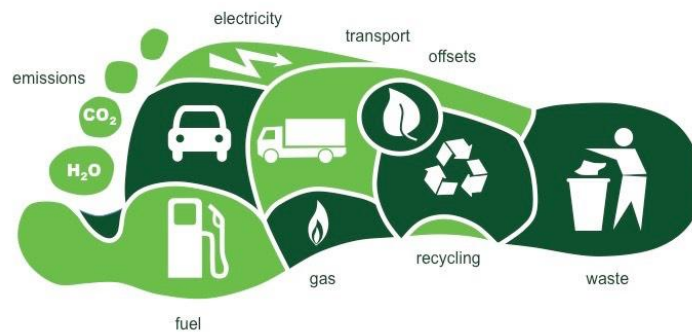
*Sylvia S Mader, Biology, 6th edition, 1998, The Mac Graw Hill Companies*

<http://www.pinsdaddy.com/carbon-cycle-in-the-rainforest-biology-of-tropical>

The beginning is the Industrial Revolution, which leads to the development and rapid growth of production technologies. The ultimate point in life cycle of human is global warming, climate change, ozone layer depletion, acid rain, deterioration of air quality and degradation of ecological balance. The basis of the Industrial Revolution is textile products. The development of mechanization, spinning and dyeing technology and other textile-related technologies in the industrial revolution has also led to the development of textile products. This development has distorted the natural equilibrium, has damaged the sustainability of life. This development design factor has also contributed to a wide range of products such as product diversity, personalized designs with the driving force of changing living conditions and socio-cultural differentiations, and the influence of the fashion factor. On the other hand; the design is being resorted to again restructuring the natural balance that has been deteriorated by the rapid development of technology and to leave a sustainable world that can be experienced by future generations. In this context, a concept emerged under the name of sustainable design. Different responses such as "sustainable design", "ecological design", "green design", "design for sustainable living", "environmentally friendly design", "environmentally friendly or environmental design", it also seems to reflect the complexity on the subject (Selamet, 2012, p.126). For this reason, it will be correct to show what primarily the work is done in the context of sustainability. Sustainability through design will be discussed later, and the subject will be covered through samples of textile and fashion design. As a result, we will try to give some clues as to what might be sustainable through design through examples of textile and fashion design.

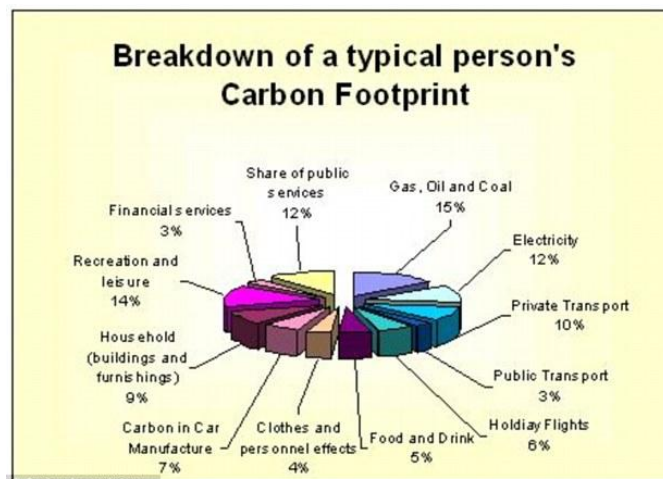
## 2. Works in the scope of sustainability and requirements to do in design of textile products

Today, the most important studies in sustainability are; carbon footprint calculation, ecological footprint, life cycle analysis for sustainable production / life cycle assessment studies. Carbon footprint is a measure of the environmental impact of human activities in terms of the amount of greenhouse gas produced, measured in units of carbon dioxide (Bekiroğlu, [http://www.emo.org.tr/ekler/49c17cab08ed10e\\_ek.pdf](http://www.emo.org.tr/ekler/49c17cab08ed10e_ek.pdf)). 'Personal carbon footprint account and corporate carbon footprint account are two-step. It is a concept that shows how much we are personally responsible for the emissions released to nature during our annual life activities. The intent is to start with people who reduce emissions by ensuring personal consciousness. Because institutions are also the basis of people. Institutional footprint is the concept that shows the emissions related to the annual activities of the institutions' (Bekiroğlu, [http://www.emo.org.tr/ekler/49c17cab08ed10e\\_ek.pdf](http://www.emo.org.tr/ekler/49c17cab08ed10e_ek.pdf)).



*CarbonFootprint*

[http://ib.bioninja.com.au/\\_Media/carbon-footprint\\_med.jpeg](http://ib.bioninja.com.au/_Media/carbon-footprint_med.jpeg)



*A Person's Carbon Footprint*

<http://www.dailymail.co.uk/sciencetech/article-3336556/What-carbon-footprint-email-Report-reveals-real-cost-making-tea-opening-spam.html>

Ecological footprint is a method of calculating the burden of a given population of nature. It calculates the area that is needed to provide renewable resources for people, biologically fertile and watery' (<http://www.biyolojidersnotlari.com/ekolojik-ayak-izi-ve-karbon-ayak-izi-nedir.html>). At the same time, ecological footprint is a way of making healthier living, healthier, sustainable textile products, producing natural raw materials for textiles, and leaving a livable world to future generations.



Carbon Footprint

Ecological Foot Print

- 1) [https://www.123rf.com/photo\\_27977819\\_the-ecological-footprint.html](https://www.123rf.com/photo_27977819_the-ecological-footprint.html)
- 2) <https://ecology2011tamara2011sp.wordpress.com/2011/03/07/ecological-footprint/>

Life cycle analysis / life cycle assessment is a system that assesses all environmental dimensions, from the raw material of a produced product to its natural origin, from all waste to return to the environment. The Life Cycle Assessment is used to determine and measure both direct (emissions generated during production and energy used etc.) and indirect (raw material disposal, product disposal, consumer use and disposal etc.). (Balpetek Alay, Özdoğan, 2012, pp.37-49).

In the life cycle analysis, the producer is expected to take responsibility for the pollution that arises from the process of design to manufacture and to produce in such a way that it will not cause any harm to the environment at least, or even at all.

Therefore deterioration of ecological balance should be prevented and eco-consciousness should be developed in the world. Sustainable designs should be made to remove increasing environmental and health problems. Sustainable design and production must be made a social responsibility.

For sustainable design, it is necessary to focus on life cycle analysis to produce and produce appropriate designs. During the design and production phase of the product, the impact on the environment needs to be investigated and detected in detail.

For example, what are the characteristic features of different stages of a textile product during its life cycle? Where the destructive effects of the environment are most intense? What is the carbon footprint of your product? In other words, how much CO<sub>2</sub> is released into the atmosphere as a result of the production and use of the product? How much energy does the product consume while in production and in use? Does your product or production process cause gas and compound emissions to the atmosphere? As a result of the production phase or use of the product, are there any wastes likely to affect vital eco systems in the waterways?

(<http://www.armadayazilim.com/Content/images/183a16f0-7f30-461c-abdb-47b89efc0478.pdf>)

### **3. Sustainability through design**

Sustainable design is directly affected by environmental conditions. The designer serves sustainability directly for a living environment when designing from natural sources. It is design and production made from natural, renewable and recyclable materials that come to mind first in terms of sustainability through design. The second is to design and produce environmentally friendly functional products while maintaining the balance between environment, society and economy. The third is to design and produce long-lasting durable products with natural materials, long-lasting durable products with renewable and recyclable materials, innovative multi-functional products by evaluating waste materials.

Sustainable design encourages innovative and creative product designs and productions to live in a qualified, sustainable environment. Therefore, innovative products that create added value and, most importantly, sustainable products will emerge.

Sustainable design; the material to be used provides the production processes that are beneficial by making improvements and innovations in the production process and less or no harm to the environment. 'Reduce energy consumption. Reduce or control product development costs by reducing risk and liability issues' (<http://www.armadayazilim.com/Content/images/183a16f0-7f30-461c-abdb-47b89efc0478.pdf>).

It evaluates the harmful effects on the environment and human beings and provides design and production in this direction. To this end, it encourages innovation, increases the efficiency of design and production, reduces costs, increases product efficiency, increases market share by introducing high value-added products from a commercial point of view.

Design through sustainability, recycling, renewable materials, re-use and traditional production can be accomplished by using four different methods, one by one.

### **4. Sustainable design in fashion and textile products**

The aim of the Sustainable textile and fashion studies is the interest in healthy living, the development of environmental awareness of social responsibility, the designing, protecting and securing of the future consciously, as much as possible to erase our carbon footprints in the world.

When we look at the data of Earth Pledge, a non-governmental organization promoting sustainable development; we see that today more than 8 chemicals are used to convert raw materials into textile products, while 25 percent of insects and pesticides are used for non-organic cotton production. As a result of excessive consumption, we throw 40 kilos of clothes a year. These methods are harmful to nature as well as to people who buy and use these products. Only two or three of the carbon footprints of an outfit come into play after being purchased.

Sustainable fashion, also called ecological fashion or eco-fashion, is the new trend of fashion with the most general definition of environmentally friendly, recyclable, high quality products. The aim from sustainable fashion is to create sustainable systems, to protect the environment, to increase social responsibility, to create conscious consumers, to reduce the shopping madness to the minimum, to reduce the money spent

for the textile sector, to slow the fashion trends consumed quickly, to regain our respect for nature and green.

The first step in sustainable fashion can be said to have taken place in 1989 when Martin Margiela used recycled textiles in his Summer collection. The spread of this current and the philosophy is possible by reaching a high level of consciousness and culture. Supporting brands and starting to make production in organic fashion frame started. Chanel, Alexander McQueen, Marc Jacobs, Banana Republic, Levi's and H & M are brands that embrace sustainable fashion.

([http://ww2.modagami.com/detay/4405/surdurulebilir\\_moda](http://ww2.modagami.com/detay/4405/surdurulebilir_moda))



Martin Margiela's recycled textiles

[http://ww2.modagami.com/detay/4405/surdurulebilir\\_moda](http://ww2.modagami.com/detay/4405/surdurulebilir_moda)

The starting point and the most important factor in the design and production of sustainable textiles is the material. The main purpose is to use ecological balance intact natural material and to make the production of natural materials sustainable. With this target; The main raw materials are cotton, bamboo, linen, ramie, jute, wool, goat hair, silk, camel hair, vicuana, rabbit hair. The fibers that are on the agenda in the scope of innovative natural materials in recent years and evaluated within the scope of development of sustainable natural materials today are soy fiber, banana fiber, pineapple fiber, coffee fiber, coconut fiber. Increasing the diversity of newly produced fibers is a necessary work in terms of sustainable textiles.

Recycled natural fibers were accepted in trade fairs, trend forecasts, industry magazines / sector magazines in the 1990s. In the mid-2000s; organic renewable fibers have taken the place as the innovative idea in design and have become the leader. Many companies have used natural and renewable, ecological alternative materials in their products. Natural fibers are environmentally friendly fibers suitable for recycling and reuse. They are low density, comfortable and healthy.

Recycling makes the production of natural materials permanent and can convert the fabric into reusable fibers and yarn and then into fabric again. Recycled fibers, yarns, home textiles or garment fabrics can be used as auxiliary materials such as heat and sound insulation where long-term use is not feasible. As well as petroleum-based synthetic and cellulosic raw materials used both in the industry and in the textile industry, many different and new technologies have been developed, such as glass fiber, steel, silver etc. the raw materials can be made usable again. This process must be realized by means of chemicals and production methods which will not harm nature.





Recycle Denim Trousers

Recycle Denim Mobile Phone Case

<https://play.google.com/store/apps/details?id=com.denimpro.myapplication&hl=tr>

Producing textiles by recycling fiber, yarn and fabric removes many operations based on energy consumption which is a source of pollution. During production, it doesn't need to operations such as repainting and cleaning. There is no need to wash with large quantities of water as in processing raw yarn. Demand for lacquers and fixatives are reduced.

Another method of sustainability is the use of renewable materials. Instead of oil-based fibers, renewable fibers that can be produced continuously in nature such as nettles, soybean filaments, and banana fiber, wool-like recycled fibers, materials made from corn starch-like materials reduce our dependence on oil.

Another method is re-use. Household materials (curtains, bedspreads, etc.) that are in a usable condition may be offered for reuse by sale and donation. Clothing that can not be worn and unused interior and exterior home textiles can be used for different purposes such as car filling material, sound insulation, panel covering. Non-reusable garments and home textile products can be designed and manufactured for different purposes. For example, fabrics that are not used in companies' stores can be reused by turning them into a seat.



Tejo Reims of Droog Design designed this legendary "rag chair" made of textiles belted together (Source: Design Navigator, 2004)

<http://www.sda-uk.org/materials/recycled/cool%20recycled.htm>



The fourth sustainability method is traditional production. Traditional production of natural materials such as cotton, linen, ramie, sisal, jute, wool, silk will reduce chemical consumption and water consumption in large quantities.

The trend in today's material and fabric choices is to introduce innovative, diverse products with many features that are resistant to bacteria, eliminate bad smells, and enhance the added value of the product, such as providing protection to the sun's rays. These new products are mainly produced from artificial textile fibers obtained from petroleum. Such properties result in a large number of chemical uses, more waste, more energy consumption (Önlü, Hometextile, May 2015, p.46). However, all natural materials such as cotton, wool, silk, linen, bamboo, natural fibers such as newly developed soy fiber, banana fiber, pineapple leaf fiber, coffee fiber, coconut fiber and so on have properties such as resistance against bacteria, protection against sun rays, destruction of bad smells.

For example, wool provides protect against sun rays. It has thermal properties by providing summer and winter heat balance. Wool has kept body cool in summer, warm in winter. It does not wrinkle easily. It is water repellent and does not draw water and moisture easily. It keeps moisture inside, does not transmit to the body. When production is improved and quality is improved, there is no need to produce an oil-based fiber by mimicking the properties of wool. At the same time, wool is renewable, recyclable.

Soya fiber, a newly developed natural fiber, is a protein-based renewable herbal lifting. It is 100% nature friendly. Wastes that are released during fiber production can be used as soybean oil and animal feed. Soya fiber has similar properties to silk and cashmere and is much cheaper than them. The soya fiber is antibacterial because of the amino acids present in its structure. Amino groups enable the activation of calogen proteins in human skin. At the same time, it promotes air uptake thanks to its superior air permeability. Soybean fiber, which is a bio-engineering wonder, has silky fineness, low density, high strength and elongation properties.



Towels made from soya yarn

<http://www.banyobanyo.com/?urun-2267-banyobanyo-antibakteriyel-havlu-50x100>

Another innovative textile product that is a good example of sustainability is coffee-reinforced fabric. It is of natural origin, Singtex Industrial Co. developed and marketed commercially under the name S. Cafe.S. Cafe has been made of composite fiber and coffee ground. One of the important features of the fabric is that it naturally protects

against bad smells. The natural aroma of the coffee is removed during the production of the fabric. The production process is similar to the production process of bamboo fiber. Yarn is made by carbonization of coffee particles at 160°C. The most prominent features of fabrics made with coffee-reinforced are that they provide protection against bad smells and harmful UV rays and dry more quickly. Since the structure of the coffee bean is porous, the coffee-reinforced fabrics have better air and moisture permeability.



Coffee- Reinforced Fabric

Natural Woven Textile Fibers, Science and Technology, June, 2014, 65-66.  
[https://issuu.com/sacittademir/docs/bilim\\_ve\\_teknik\\_-\\_haziran\\_2014/66](https://issuu.com/sacittademir/docs/bilim_ve_teknik_-_haziran_2014/66)

The first garment made from coffee-reinforced fabric is a sportswear produced by French company Eider Action Wear. However, the fabric has attracted well-known companies such as Timberland, New Balance, North Face, Nike and Puma. The production of these companies reveals that coffee-reinforced fabric is not just a fantasy product for coffee lovers.

(Natural Woven Textile Fibers, [https://issuu.com/sacittademir/docs/bilim\\_ve\\_teknik\\_-\\_haziran\\_2014/66](https://issuu.com/sacittademir/docs/bilim_ve_teknik_-_haziran_2014/66)).

Another way of achieving sustainability through design is to design and produce new products that will provide sustainability by mimicking nature or inspiring from nature within the context of biomimesis, biomimetic and biomimicry concepts. 'Biomimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies. The goal is to create products, processes, and policies—new ways of living—that are well-adapted to life on earth over the long haul' (<https://biomimicry.org/what-is-biomimicry/>). The end result is bio design. For example; Lotus leaves are self-cleaning. The fabrics produced by inspired from nature provide water and energy conservation, provided they use low-grade and least-grade chemicals. The Velcro / Velcro designed by inspiring the Velcro plant reduces many steps in the production and saves energy.

Designing and producing by evaluating waste materials is another design sustainability study. The reuse of unused wool blanket as carpet and rug is a good example of sustainability design.



Redesign of unused wool blanket like carpet and rug  
 Tejo Remy and Rene Veen Huizen, 2008  
<http://www.remyveenhuizen.nl/work/products/accidental-carpet>

Production of print design designs using digital and transfer printing methods instead of conventional printing methods such as rolls and templates is a good example of designing and producing environmentally friendly functional products while maintaining a balance between environment, society and economy.

Designing and producing printed textiles in this way contributes to sustainability as it means less paint use, less pollution, less water consumption. With digital printing the patterning of the textiles results in less pollution and less water consumption because less dye is used and spray dyeing is done. Because digital printing technique is in development stage, it is suitable for fabric dyeing and printing in lower quantities. Transfer printing consumes 2 kg of water to produce 1 kg printed fabric while 250 kg of water is consumed in conventional printing. In terms of lacquer, many natural dyestuffs such as plant roots, leaves, plant shells only paint natural materials. Light and color fastnesses are low. Metal mordanting is required to hold the paint. This means that high pollution and wastes damage the environment. It is, however, safer than synthetic dyes containing salts. After dyeing, untreated stains and chemicals require a lot of water to clean. One liter of water requires 100 gr of salt.

Since natural stains only paint natural materials, water based fabric dyeing should be preferred as they are both natural materials (fiber, yarn, fabric) and artificially colored ones. With an environmentally friendly approach, reactive dyestuffs with low salt content have been developed.

In sustainability through design, in the process of transition from design to production accurate production calculations must be made. The use of unnecessary yarns that cause more yarn dyeing or more balls dyeing should be avoided. It is necessary to avoid unnecessary fabric production, which means unnecessary energy consumption and stock accumulation.

## 5. Sustainable design strategies

We can address sustainable design strategies in three stages: product-focused design, result-oriented design, and requirements-driven design. The product-focused design is to design products that are multifunctional, long-lasting, out of fashion, and to make existing products more efficient with innovative ideas and to reduce harm to the environment. Result-oriented design is to put out designs for a specific purpose.

Requirement-driven design is to design products that stimulate consumption by identifying real needs to make a difference.

Designing and designing products by designing strategies, as we constantly emphasize, requires less energy consumption, less water consumption, less chemical, less harmful gas, etc. publishing. It is possible to reduce environmental pollutants and wastes, to use environmentally friendly natural fibers and materials and resources, to encourage slow fashion instead of fast fashion, to encourage the reuse of sustainability textile products, to design and produce products by designing strategies.

## 6. Result

Products produced through sustainable design should not only be produced as environmentally friendly products that do not harm nature, but should also be able to maintain the characteristics of appealing products with aesthetic qualities at the same time.

The resulting products should have more qualified features such as being multi-functional, beneficial improved product rather than the products produced in the usual way. Designs should be made for the real needs, which are continuous, always preferable, rather than the products that are felt to be fashion and needy.

In this context, sustainable design products should be designed to reduce natural resource consumption and minimize the harm to the environment in the process of production and consumption. In the design and production phase, energy sources such as solar, water, wind should be preferred instead of nonrenewable natural resources.

In textiles, materials that do not damage nature should be used in the dyeing of both yarns and fabrics, in dyes to be used in printing design products, and in chemicals to be used in finishing operations.

In line with these proposals, it would be useful for designers and businesses to adopt lean manufacturing systems within the scope of sustainability. With lean production, more conscious products can be designed and produced that is focused on the usage target and which will eliminate the stocking from the market by analyzing the consumer's desires correctly.

The balance between consumption and production, as mentioned above, can be provided by making improvements in quality, cost, product delivery method. The products designed for the real needs of the consumer are able to designed and made multifunctional, using less resources in the production phase and less damage to the environment, by making fast and errorless production in a shorter time.

As a result, the basic features expected from a design are manufacturability, functionality, visual appeal appealing to consumer liking, and marketability, that is, acceptability and affordability by the consumer.

It is extremely important that one of the essential features of design is sustainable in order to design and protect the future consciously. That's biological design. To design and produce by allowing the nature to be renewed without harming the nature by watching the nature.

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