RECOMMENDATION
E-textiles which give power
These e-textiles are most suitable for the commercial fashion-industry at the moment. This category has the most possibilities and is most highly developed in the field of e-textiles. Consumers will use these products faster and longer than the products in the other categories, because it provides an absolute function to the user.

E-textiles which change in colour
These e-textiles are already well developed, but still need a lot of development and research. In long-term this category offers a lot of potential in the commercial fashion-industry, but there are many interesting options possible already with thermochromic and photochromic systems and electronics.

E-textiles which change in shape
These e-textiles are least suitable for the commercial fashion-industry now. This category needs most time, research and development in the field of e-textiles. The e-textiles are especially interesting for a product in long-term, so the view on the category is very futuristic and less profound.
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E-TEXTILES WHICH GIVE POWER
WHAT FUNCTION

We all know how frustrating it is when your battery dies and you’re unreachable. A product in this category will prevent this. These products can convert sunlight into electricity and charge smartphones or any other USB systems. In sunlight the product produces electricity, enough to charge a typical phone in a few hours. But also indoors the product can produce enough energy to charge a phone. The product can charge smartphones, MP3 players, cameras, GPS systems and other USB-compatible handheld or portable devices. Electricity can also be stored for later use in a battery pack.

WHY FASHION

People wear every day garments. Wearing solar cells let us harness the sun’s potential energy and become a power source ourselves. Solar cells can be added to the esthetical of garments, and this value can be combined with the functionality of solar cells. With technology it is possible to seamlessly integrate the technology of solar cells and the design, so they mutually inform each other, advancing the concept and value of fashion. The product will be attractive and practical at the same time. Technology and fashion can complement each other to create desirable clothing that has a function.

WHERE ELECTRONICS

The technology that is used in this category enables extremely thin electronics that are stretchable, flexible and washable. It can be integrated into textiles using standard high-volume techniques that are well known in the textile industry. The maturity of the technology means textile manufactures could bring functional fabrics to market in a matter of months using existing production facilities.
WHEN

Short term, the products in this category are ready to wear. There are several hurdles and obstacles for products with e-textiles, such as the moving body as well as creating a garment that can be washed. In this category these obstacles have overcome, the products are washable and flexible.

Thereby the solar cells can be mass-manufactured in a cost effective way by Roll-to-Roll compatible technologies, and then incorporated into the fabric using familiar industrial ‘iron-on’ techniques before the garments are stitched. That gives designers the freedom to create their own designs.

WHO

The acceptation of the technology in clothes will start by the early adopters between the 18 and 35 years old. They will pick up the technology and see it as gadget. They will experience the functionality, comfort and added value of the products, it make their daily life more practical and easy. The majority of the consumers, the mainstream consumers, will be motivated to adopt the devices after that.

Furthermore, a product in line with the technology of solar cells, which can give power, could be very interesting for COS. The innovation in textiles and designs attracts urban creatives.
A collar is interesting for a fashion company, because the user can turn off the collar when he or she doesn’t need it. When the sun shines the user can put it on and generate energy on a fashionable way.

The material of a bag is mostly thicker than the material of a garment, so it is easier to integrate the electronics and solar cells in a bag. Thereby the user conditions are easier, the product does not have to be flexible and washable.

The idea of the belt is the same as the collar, it is the choice of the user to wear it or not. The material of a belt is also less flexible and the users don’t wash it, so it is easier to integrate the solar cells and electronics.
A heat is a perfect product to generate energy of the sun, because the user will wear it very high. The product is perfect to get the optimal charging result, and there is the possibility to wear it or not as well.

A scarf is more difficult in the category of short term, because the fabric needs to be soft, functional and smooth. If the solar cells are integrated on the endparts of the scarf, it is more possible to use solar cells in a scarf. Still it is an interesting product, because it is detachable.

Jewellery is mostly made of hard materials, so it is easier to integrate electronics and solar cells. It is important that the battery is very small, to use it in jewellery.
A coat is for garments a good option to integrate electronics and solar cells, because the material is mostly thicker and less flexible. The user will not wash a coat and will not wear it a day long. Thereby, it is also worn outside, so it is perfect for adopting sunlight.

A dress is more difficult, because it needs to be flexible, washable and comfortable. It is very interesting for the fashion-industry, because it is possible for the design to use solar cells in only some parts of the product. The user can revealed the parts when the sun shines or folded away when they aren’t needed.

The skirt is interesting for the fashion-industry in long-term, because the solar cells can be placed in only one part of the product, such as the waistband. The design of the skirt can have an pocket outside for the battery, but also inside the dress.
Knitwear is a good option for the use of electronics and solar cells in a product, but it is also difficult because the fabrics are very stretchable and light. If the knit is more thick, it is easier to integrate the elements.

A top is a beautiful option for the fashion-industry, there are some very nice designs already in the market. The solar cells can be used as decor for the shirt in an elegant and stylish way, the product is attractive yet practical for the user.

Swimwear sounds impossible, because it gets wet most of the time, but it is possible. There is already a solar cell-bikini, because the cells are in fact waterproof. A very important note for swimwear is that the swimwear needs to be completely dry before any device is attached.
For all products it is interesting to use the energy for LED lights, instead of charging devices, for the safety of the user, or just fun reasons. The LED lights need to be integrated in the garment then.
PRODUCTS WITH SOLAR CELLS
### ADVANTAGES
- The product will be functional and practical
- Consumers will accept and use the products fast
- Resistant to everyday use, as washing and movement
- Mass-production is possible
- No need of electricity for chargers anymore
- It’s the sustainable answer to our increasing demand for energy and connectivity
- Clothes with a super power
- Possibilities are short-term
- Product can be folded, that will not damage the solar cells
- Good longevity of the product

### DISADVANTAGES
- Need of battery, conductive threads and a charger
- The cost of the products are high
- The looks of the designs are the same through solar cells
- Use of hard elements
- The solar cells need to be more flexible
- People needs to be used to technology close to the body

### THE STEPS

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<td>2</td>
<td>Generate energy</td>
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<td>3</td>
<td>Charging</td>
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PRICE INDICATION

- BAG: $99 - $500
- JACKET: $599
- BIKINI: $200
- NECKLACE: $800
- PHONE CASE: $80 - $90
- PANTS: $920
- SUIT: $750
- BROOCH: $184

CHARGING IN HOURS

- SUNSHINE: 2-3 hours
- CLOUDY: 5-10 hours
- RAINY: 13-20 hours

*100% charge with optimal temperature and conditions.
E-TEXTILES WHICH CHANGE IN COLOUR
WHAT FUNCTION

Imagine a garment that every day could change in colour or print on itself. We are not so far yet, but according experts the future will bring that possibility. Now there are already textiles that are controllable in colour change through electronics and conductive yarns. Through the use of thermochromic or photochromic ink in textiles, it is possible to change the colour of the fabric by differences in temperature. The ink changes by itself of colour by these differences, but with the electronics it is possible to control this change by means of batteries and conductive yarns. By the use of electronics it become useful and convenient for the user, the product will remain more exciting for the consumer.

WHY FASHION

Colour change in textiles is very interesting for fashion. The goal is to create garments that can transform in complex and surprising ways, such as a chameleon. According to professor Bezowska, there would also be a performative aspect to wearing such garments in the future, whose dramatic transformations may or may not be controlled by the wearer. The textiles are very interesting for garments if all colours are possible. Imagine stores where you can buy every season new colours and new prints for your garments instead of new garments. It will have less impact on the world, because it creates a close, intimate and unique connection between the user and the garment. The longevity of products will extend through colour change, consumers will see the relevance of garments and the product will remain more exciting for the consumer.

WHERE ELECTRONICS

For colour changing textiles you need thermochromic ink, batteries and conductive threads.
A sensor detects certain stimuli, such as touch or movement, and reacts through change in the colour of the fabric. In response to the stimuli, the batteries will produce electricity, this electricity will be flowed through the conductive yarns. Because of this flow, the yarns will heat up and change in colour by the thermochromic ink.

A second technology for colour changing is the use of smart foil. A sensor detects stimuli from the surroundings, such as a person coming closer. The sensor reacts by sending electricity through the foil, so it will change in colour or degree of transparency. The advantage of this technology is that it not depends on temperature. A disadvantage of the technology is that it not textile worthy is. The foil is hard and uncomfortable for a garment. Thereby, there are only two colours possible, black and transparent.

WHEN

Long-term. We strive for garments that can change in colour every day without the need of a lot of energy and even without the garment becoming hot. The technology is not so far yet that you can give another colour to your shirt one day, and give it another colour the next day. That simply uses too much energy, and is not sustainable. It shouldn’t depend on certain influences from sources, such as electricity. It should change from colour by itself. For the consumer it is unpractical when the garment needs to be warm for colour change, which is not functional so close to the body. For now, the textiles are not stable enough for consumer use.

WHO

The early adopters in our society will be experience the products with colour change first. They will use it as playful effect to their garments, or as gadget. If the technology is so far that clothes can change in colour by themselves, it will be accept by the biggest part of the market. The mass will get used to it that clothes and stores are changed.
Socks are already interesting for the commercial fashion-industry, because it is not annoying if socks heat up in the winter. It is useful and fun to heat up your feet and change the color at the same time.

For garments it is a good option to change the color of one part of the garment, for example the collar or the cuff of a shirt. This is a better option than the whole garment, because the color changing part will heat up. It is not functional for the user if the whole garment heats up.

Imagine a scarf that keeps you warm and comfortable when you are very cold in the winter, and change in color at the same time. The product will be functional yet fashionable for the user.
Jewellery is interesting because it is a very nice detail to change the colour of jewellery, while it is not very annoying for the user when it heats up because it is small and removable. For the jewellery it also very easy to use the smart foil for colour changing, because materials can be hard.

A bag, made of a textile, is a good choice in this category. To use the conductive yarns, the bag needs to be made of a textile, so not leather. Another option is to use the smart foil on a part of the bag for colour changing. For a bag it is not that important that it is flexible.

The gloves are for the same reason interesting for the fashion-industry as the socks and scarf. The colour change will improve the function of the gloves through heating up, thereby it will be fun for the user to change the colour of the gloves.
This category is for garments very difficult at the moment, because garments will heat up. It is not functional for the user, because the body of the user is already warm.

Garments are interesting for long-term, because they are very potential in the future of colour changing. It is a nice option now for garments to change the colour of only one part; it gives a nice and stylish detail.

For some garments, for example a coat or knitwear, it is not annoying when it heat up. It needs to be warm for the user, so it can be functional as well. The garment will be relevant for the user, and belong to the essentials. It can give very nice and playful effects to the garment when colour changing is possible without any electricity, we can also use it for more difficult products then. Think of upper parts for underwear, it will give an outfit a beautiful detail.
PRODUCTS
LONG-TERM

KNITWEAR

TOP

UNDERWEAR
Experts expect that in the future it will be possible to change the colour of a garment every day without using electricity. Now we need batteries for electricity to heat up the yarns. That means that products will heat up, so winter products will be more interesting and useful in this category.
PRODUCTS
WITH COLOUR CHANGE
ADVANTAGES

- The long-term future offers a lot of potential in the fashion-industry
- It is very interesting when there are more possibilities in colour change
- Colour change is very subtle, compared with for example lighting-up textiles
- For the consumer it will give a playful and fun detail
- Longevity of products will extend
- Clothes will be more relevance and worthy for consumers in the future
- Colour changing is sustainable, because products remain more exciting in the future
- Consumers will buy less garments in the future if there is colour changing

DISADVANTAGES

- Need a lot of batteries
- Garments will become hot, not profitable because the body is already warm
- The current e-textiles with colour change are not really functional through heating up
- Now the textiles are not stable enough for what you can do with it
- The textiles need a lot of development, time and research

THE STEPS

1. Sensor detects
   A sensor will detect certain stimuli, such as movement or touch.

2. Yarns heat up
   As reaction on stimuli the batteries will produce electricity, the electricity will flow through the conductive yarns. The yarns heat up.

3. Colour changes
   Through this heating of the yarns, the yarns will change in colour.
“We won’t see such garments in stores for next 20 or 30 years, but the practical and creative possibilities are exciting.”

Berzowska
E-TEXTILES WHICH CHANGE IN SHAPE 3
WHAT FUNCTION

At the moment there are two different ways of changing the shape of a textile: shape memory and shape change through changing the appearance of the fabric. With shape memory the textile change back in its original shape when you put power on it and the temperature changes. Think in this category of garments that get back in shape when it is wrinkled.

The other way of changing in shape is less accessible. Shape change is also possible to change the appearance of the fabric by changing the visual form. Scanning the fabric with an app and camera on a smartphone or tablet, will allow the user to see 3D objects rooted in the fabric. It shows interactive 3D objects appearing on a textile. The longevity of textile products is extending through changing the idea of what textiles can do.

In the future experts expect that there are fabrics that change their shape in response to stimuli. There are many developments in this area now.

WHY FASHION

It offers comfort and improved protection of the fabric in a product; these aspects are very important and useful for consumers. The fit and quality of garments can be improved by the use of e-textiles that change in shape. The garment adds value to the user if there is a possibility to change back in its original shape after a temporary transformation. The products in this category have great potential to belong to the essentials of the consumer, if the shape is always good.

This category brings many possibilities on long term; imagine garments that you can change in silhouette or the possibility to make the fabric thicker in the winter.
WHERE ELECTRONICS

The textile remembers its original shape as a result of an external stimulus, such as temperature. The textile will return from a deformed shape to its preformed shape when you put power on the fabric. The yarns will heat up and it will return to its original shape. These yarns are made of metallic materials. Fabrics can’t change by itself in shape now, but only remember their original shape.

The temperatures at which the material changes in form can be programmed precisely, but it needs to be very heat. The fabrics have a one-way shape memory, because it will return to its original shape if it becomes heat. Normal fluctuations in body temperature cause no reaction. The textiles can be programmed to respond to the transition from outdoor temperatures to very heat temperatures.

WHEN

Long term. Through electronics in textiles is shape memory or shape change already possible. The vision for the future is that shape transformation is possible on small scale and large scale. On small scale you can think in terms of the structure of the fabric, so from thick to thin. On large scale you can expect transformation in silhouette or fit of a product. For now that is impossible, but experts expect that the future will bring that. That will be very interesting for the commercial fashion-industry. Now is the shape change only possible for parts of the garment, not for the whole garment.

WHO

This category needs first a lot of development, time and research, but after that the early adaptors will try it and use it.
The category of e-textiles, which change in shape, is at the moment least suitable in the fashion-industry. It needs still a lot of development and research. Anyway, the category is very useful for the recommendation to see what the possibilities are for the expectations in the future. It is good to be prepared.

For the future, garments are the most interesting products in this category, because garments offer many opportunities for both playful and functional features for the user.

In the future garments can be winter and summer items at the same time, because the fabrics can for example roll up, expand or open by itself.

Think of the following options:

- Sleeves / Sleeveless
- Open / Closed
- Long skirt / Short skirt
- Tailored / Not tailored
- Folded design / Straight design
- Long sleeves / Short sleeves
PRODUCTS WITH SHAPE CHANGE
ADVANTAGES

- The expected applications in the future are amazing for fashion
- Experts expect a big future for this category, which will change the fashion industry
- On small scale is interesting in the future through changing the structure of the fabric
- On large scale is interesting in the future by changing the silhouette or fit of a product

DISADVANTAGES

- The current technology is not that far
- This category needs a lot of research, development and time
- Shape change is possible in only one-way, because of the shape memory
- The garment will heat up, that is not functional for the consumer
- Now we need too much energy for shape changing
- Now the textiles are not stabile enough for what you can do with it

THE STEPS

1. **Power on**
   The user put power on the fabric with the use of batteries.

2. **Yarns heat up**
   Through the power the yarns heat up.

3. **Shape changes**
   As response to the temperature change, the yarns will return to its original shape.
“Our future clothes will allow to change shape, cut and colour depending on your preferences and fashion trends.”

Studio XO
RESOURCES

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