from DIY-materials to industrial symbiosis

a journey through a case studies collection

diymaterials

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diy materials

materials

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Research topic:
I am investigating on how the new generation of designers can be the pull for sustainable innovations through materiality. More specifically, what can be their role in designing materials that can become the limestone of networks of stakeholders exchanging resources and by-products able to create scalable upcycled materials form organic waste.

Hello!

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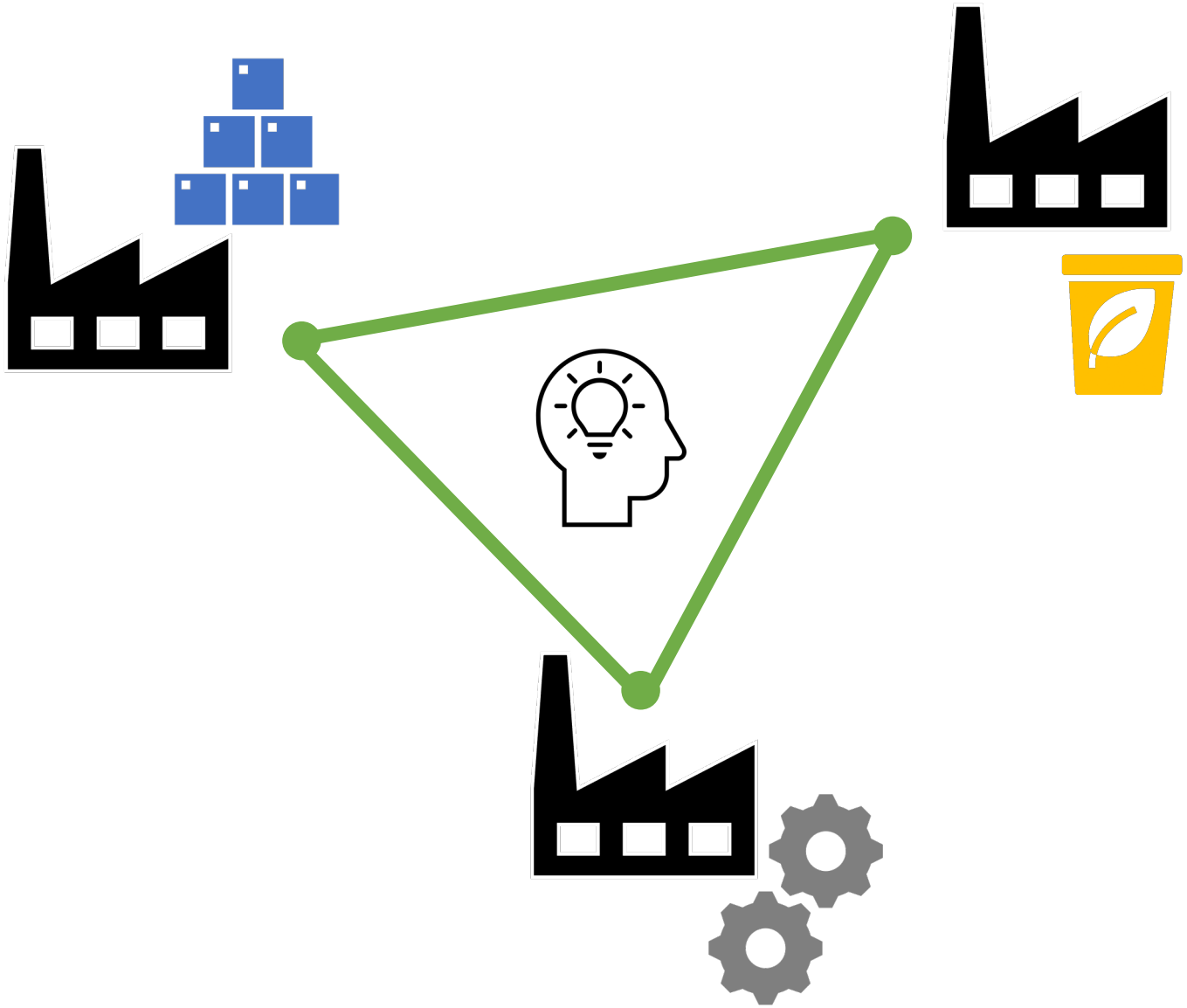
Upcycling

“is a process in which used materials are converted into something of higher value and/or quality in their second life. It has been increasingly recognised as one promising means to reduce material and energy use, and to engender sustainable production and consumption.”

(Sung, 2015)

glossary

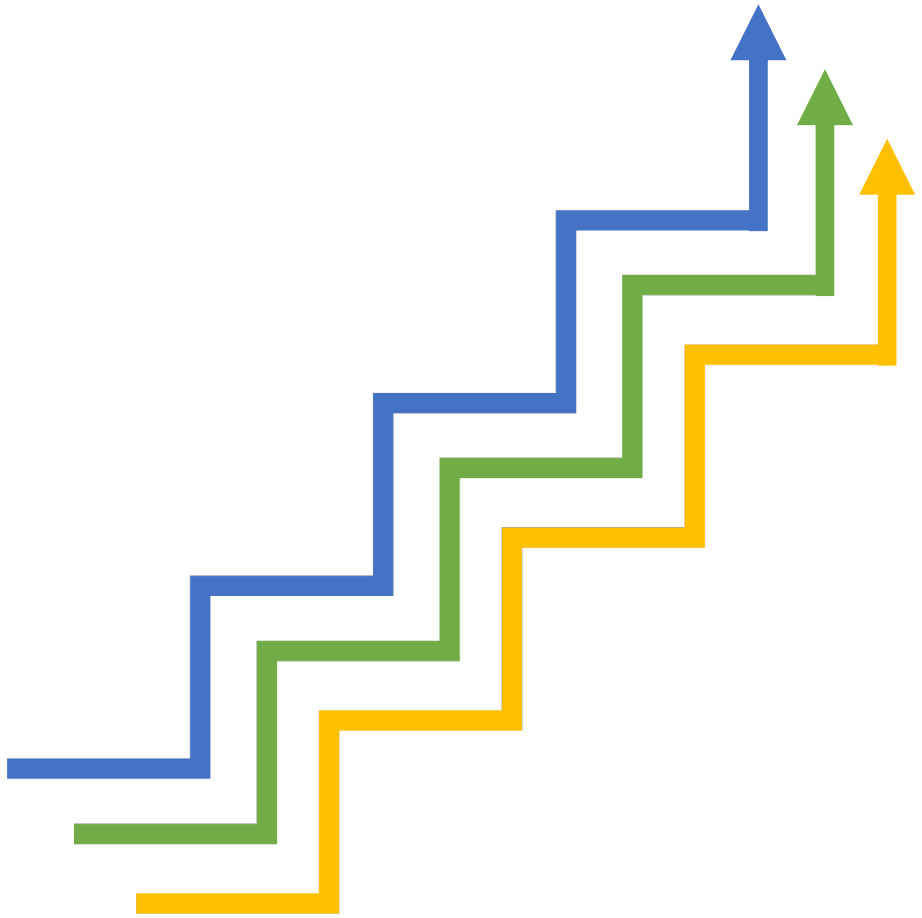


Industrial symbiosis

is a subfield of industrial ecology (Garner & Keoleian, 1995), it involves separated industries in sharing by-products, energy and water in a systemic approach creating mutual advantages (Kalunborg, DE)

(Chertow, 2000)

glossary

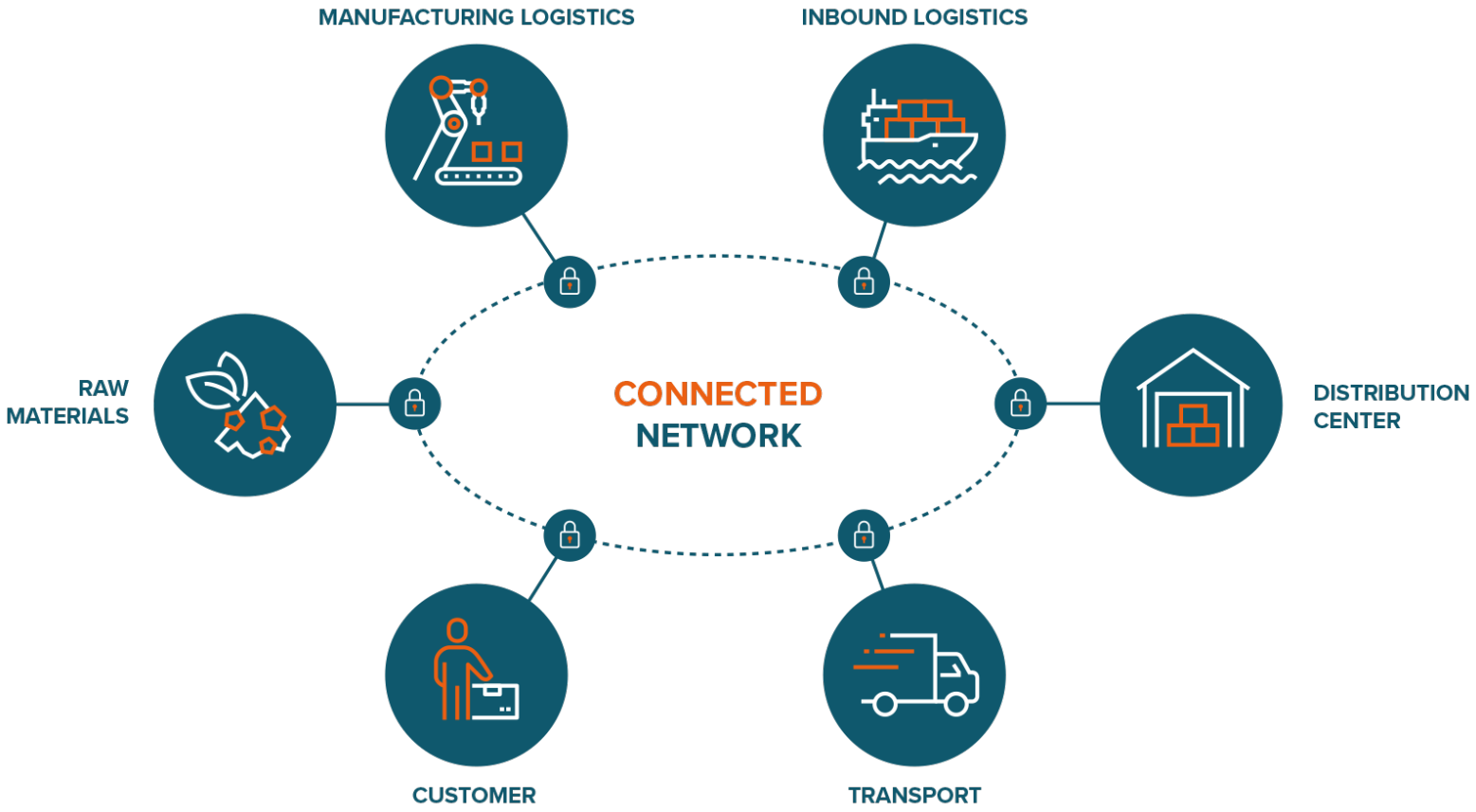


Scalability

the ability of a business or **system** to grow larger.

(Cambridge Dictionary)

glossary

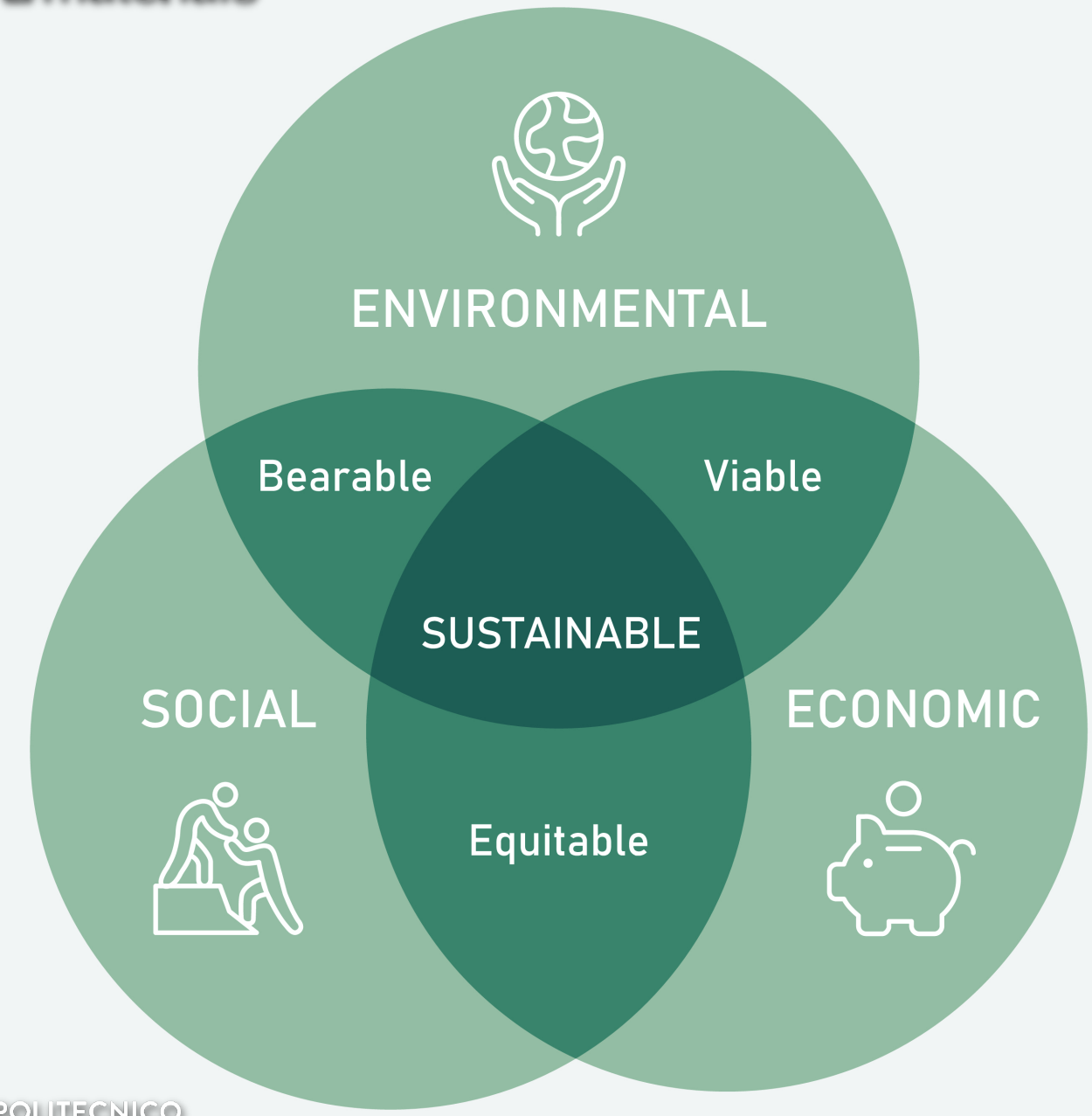


Supply chain

the **sequence of processes** involved in the production and distribution of a commodity.

(Oxford Dictionary)

glossary



Economic: it requires that projects, businesses, activities, etc. utilize resources efficiently and responsibly so that it can operate in a sustainable manner while ensuring operating profits.

Environmental: implies that we are living with the means of our natural resources and not breaching replenishment rates.

Social: is the ability of society, or any other social system, to persistently achieve a good social well-being in the long run.

(EU Commission, 2011)

glossary

Organic waste
”encompasses food and green waste, forestry and agricultural residues, animal waste, biosolids and sludges, as well as paper, cardboard and natural textiles and is usually present as a component of most waste streams”.

(Lasaridi & Stentiford, 2011)

glossary

Upcycling organic waste has a **dual value**:

- waste needs to be treated and disposed requiring energy and provoking long term environmental impact
- reusing organic waste it will avoid this burden and reduce the usage of virgin resources

(Ghisellini et al., 2016).

glossary

Our material experience

Materials take a central role as they are the primary elements in the process of design (Rognoli et al., 2021) and so are part of the product life cycle starting with all the activities needed to produce the materials and then the products themselves (Vezzoli, 2014).

context

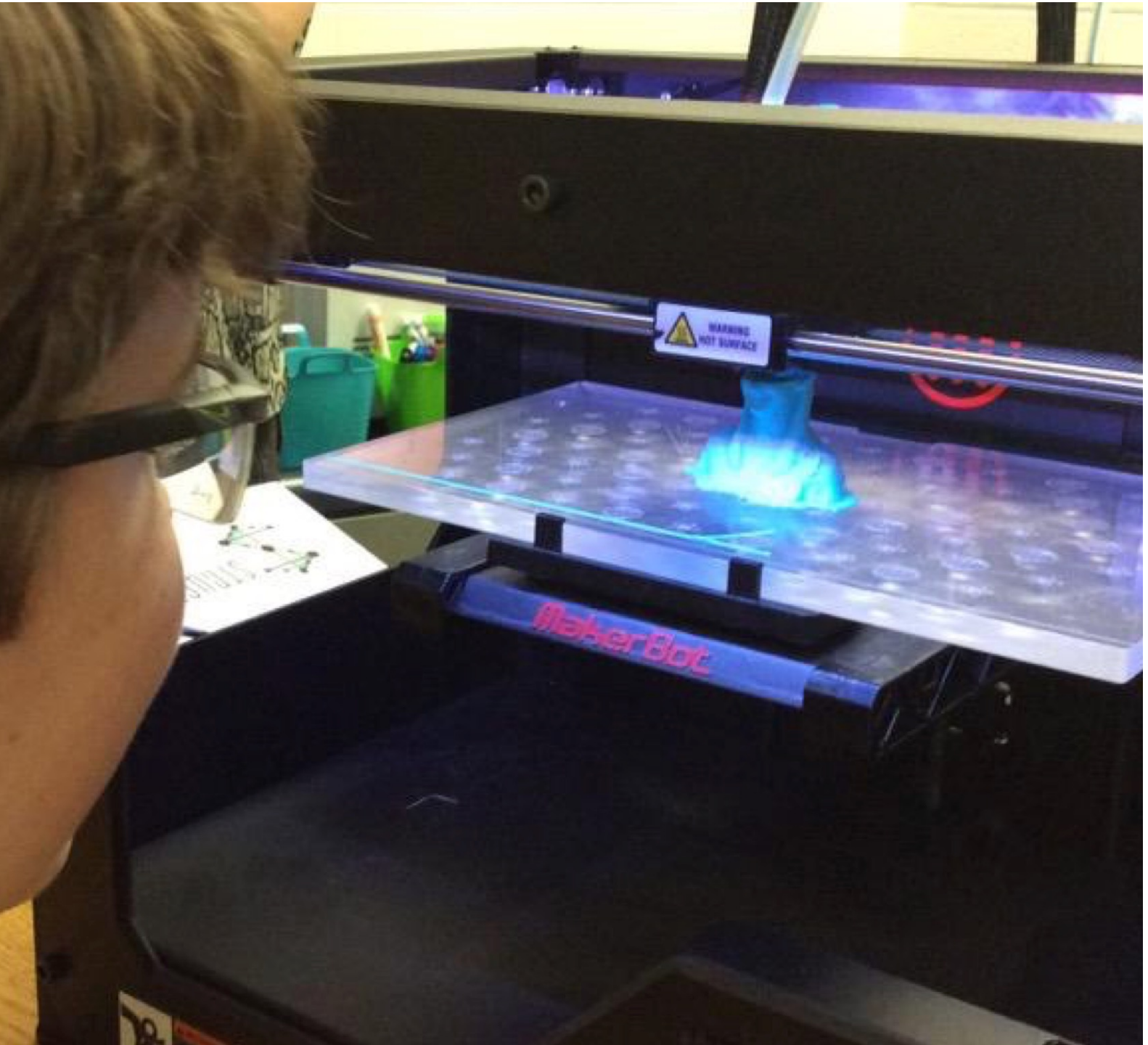
Industrial materials

Our material experience is ruled by the fact that everything we enter in contact with, come from an industrial mass production. That is to say that our material experience is based mainly from industrial materials that have been developed to be coherent with shapes efficient in a mass productive system (Rognoli et al., 2018).

context

Designers are getting in contact with matter and process again

phenomena



Technology democratization

triggers

Technology democratization

Fab Lab diffusion

triggers

Technology democratization

Fab Lab diffusion

Low-tech approach

triggers

Technology democratization

Fab Lab diffusion

Low-tech approach

DIY practices reborn

triggers

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Technology democratization

Fab Lab diffusion

Low-tech approach

DIY practices reborn

Transdisciplinary design

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Technology democratization

Fab Lab diffusion

Low-tech approach

DIY practices reborn

Transdisciplinary design

Environmental concerns

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Crisis, problems and scarcity of resources

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Crisis, problems and scarcity of resources

Social innovation practices

Openness and acceptance towards the aesthetic of imperfection (Kintsugi)

triggers

Do-It-Yourself Materials

are created through individual or collective self-production experiences, often by techniques and processes of the designer's own invention, as a result of a process of tinkering with materials. They can be new materials with creative use of other substances as material ingredients, or they can be modified or further developed versions of existing materials.

Material Tinkering

Parisi, S., Rognoli, V, Sonneveld, M. (2017)

Materials Tinkering is an inspirational approach for experiential learning and envisioning in product design education.

Marbile
by Ioanna Oikonomou, Marina Psimikaki, Yang Yudang, Marta Ziminska, 2017

examples

It’s never too la(t)te
by Aslan Dicle, Ibrahim Dinullah, Shao Yizhuo, Unal Betul, 2017

examples

Porcaria
By Gabriela Machado, Liping Ren, Luisa Yatsu, Zheng Manlin, 2017

examples

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Greenet

By Helga Aversa, Simona Bettoni, Aysecan Ertin, Muyun Wang, 2017

examples

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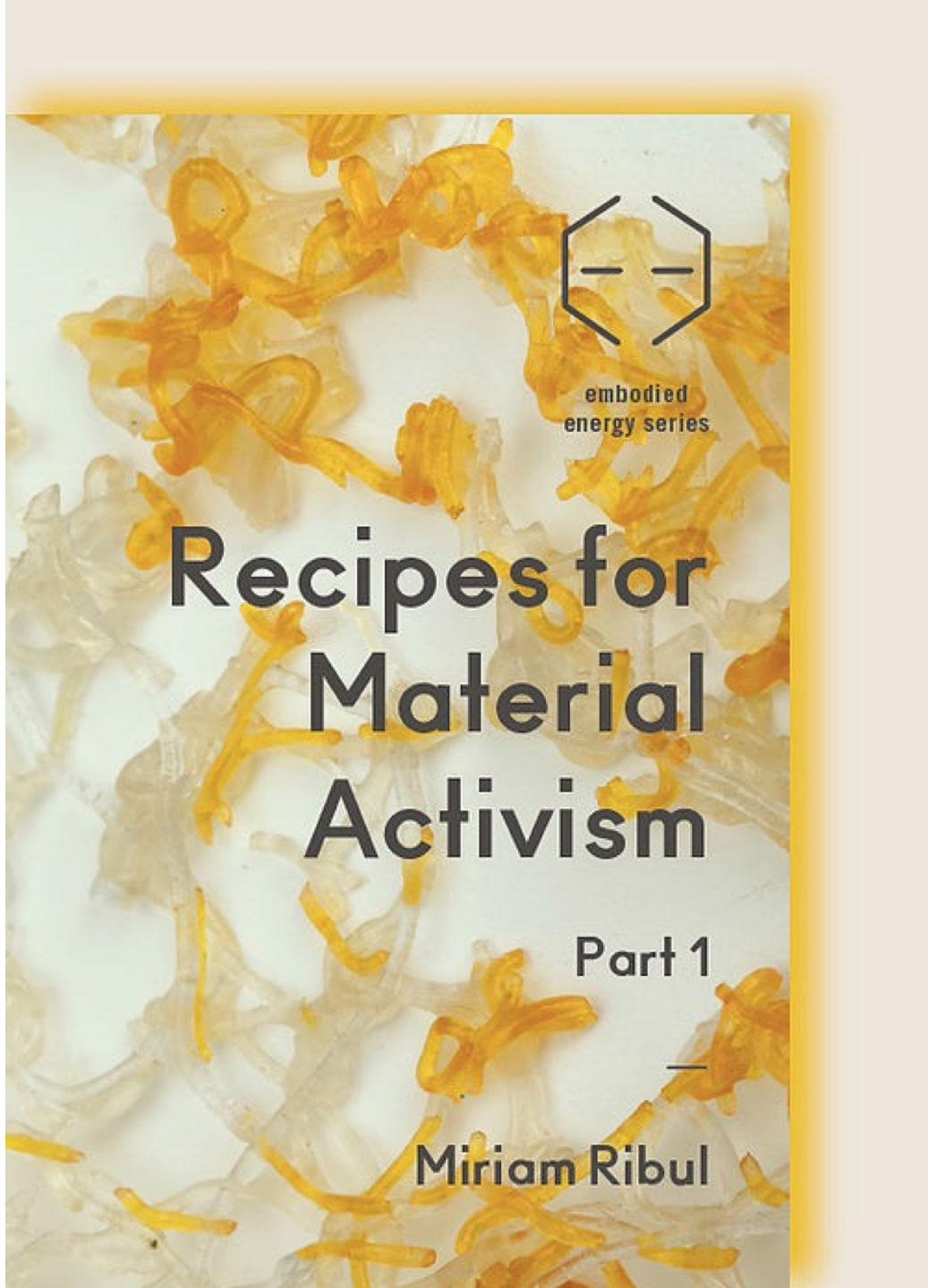
Midas
by Quentin Fedrizzi, Tina Jochens, Media Hosseini, Tamineh. Sotoudeh

examples

Think globally, fabricate locally

by Neil Gershenfeld, (2012)
How to make almost anything

cues



Material Activism

by Miriam Ribul, (2014)

Explores a low tech approach to the democratisation of production. Common tools and ingredients are adapted in the pursuit to create alternative aesthetics and processes for materials and making. In the pursuit to develop a variation of models to replace traditional manufacturing processes, each prototype implies systems for producing know materials and structures in an alternative way.

cues

Material Activism

by Miriam Ribul, (2014)

The aim is to establish an ‘activist’ design role in the context of material research and production. The project will lead to new methods for design activism and research in material lifecycles, and the development of methodologies for the trans-disciplinary collaborative process.

cues

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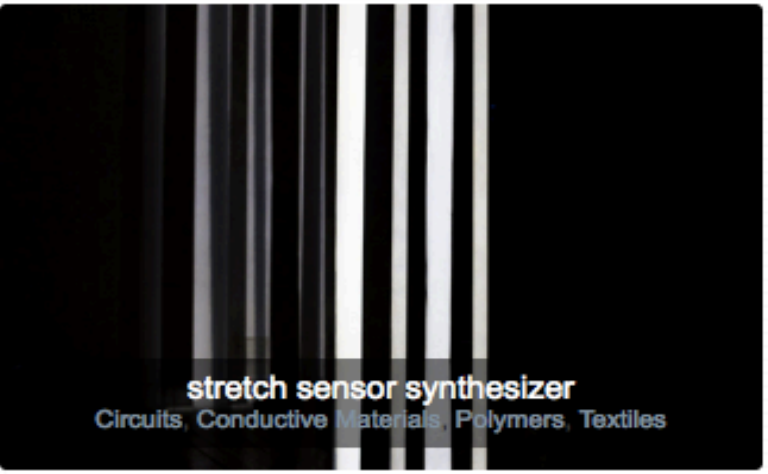

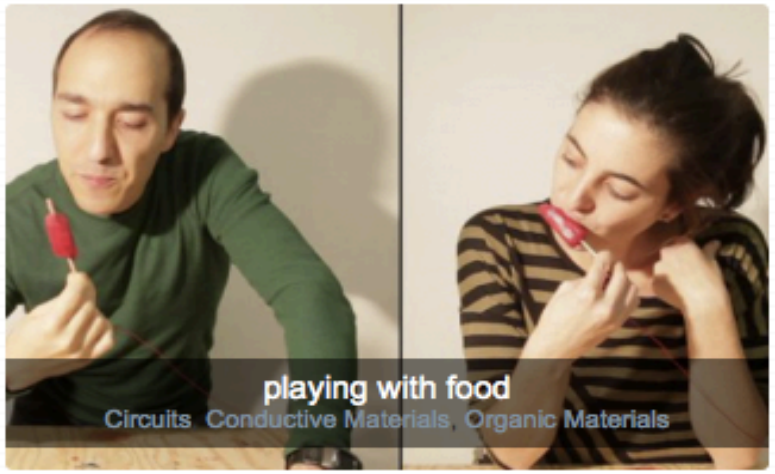

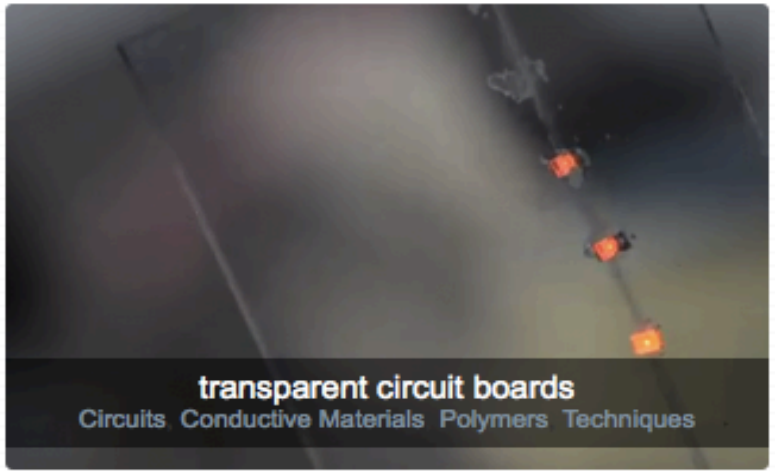

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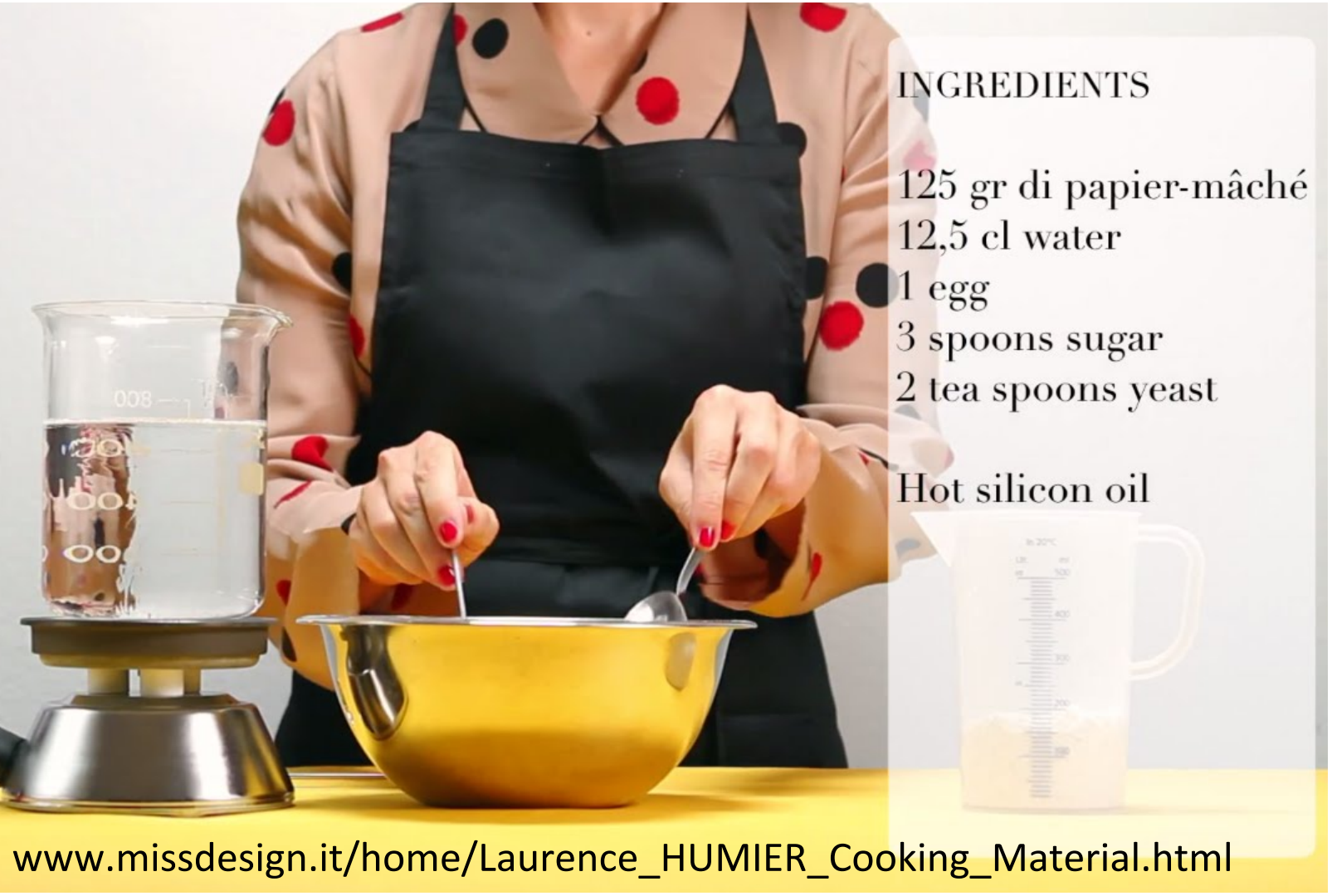
Open Materials

by Catarina Mota, (2009)

We see materials as an open resource, and wish to establish an open process for exploring and sharing knowledge, techniques and applications related to materials science.

cues

diy materials



www.missdesign.it/home/Laurence_HUMIER_Cooking_Material.html

Cooking Material

by Laurence Humier, (2012)

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Radical Matter

by Kate Franklin, Caroline Till, (2018)

https://www.franklintill.com/work/radical-matter

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Why Materials Matter

by Matter, Setaal Solanki, (2018)

https://www.ma-tt-er.org/discover/

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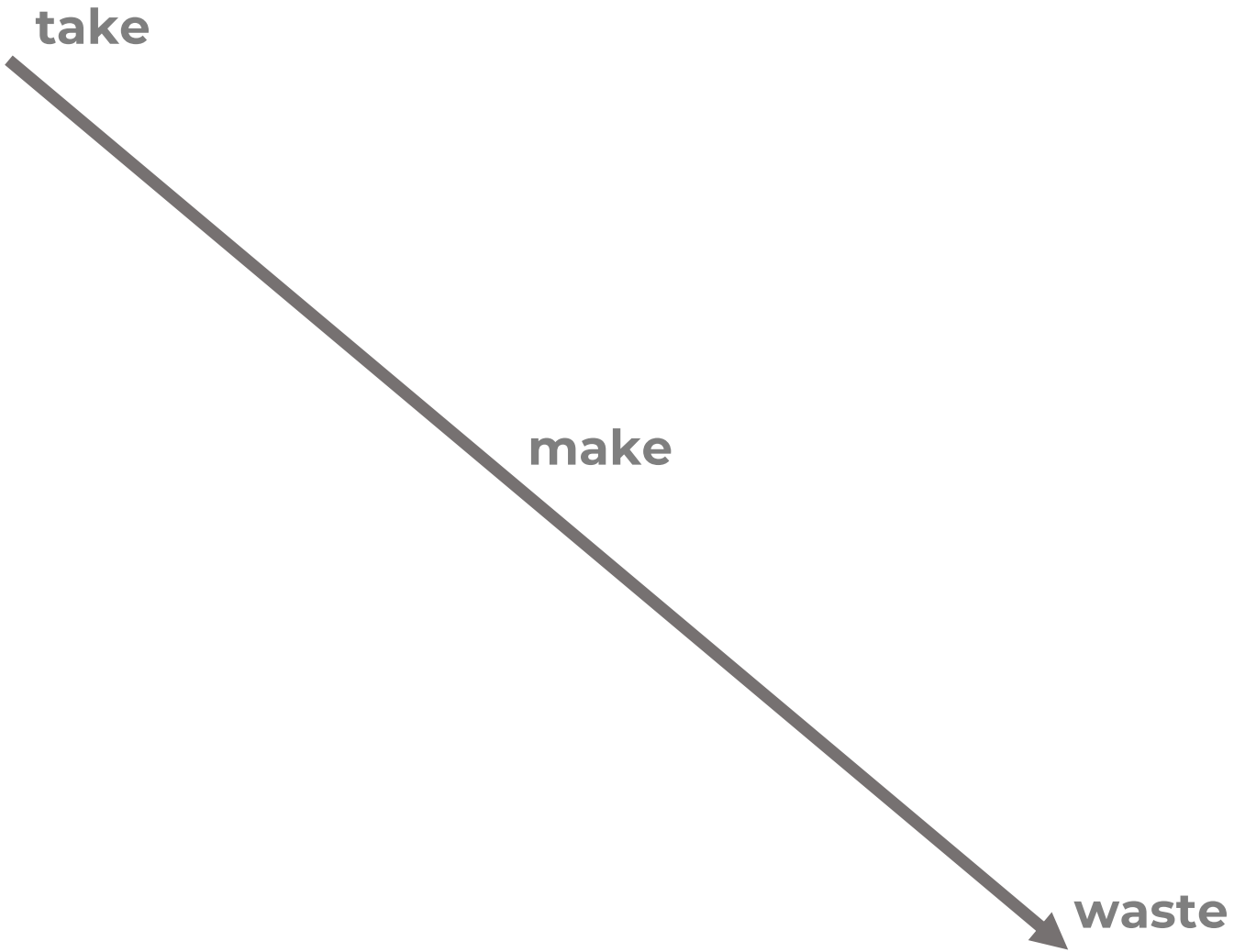

Economies worldwide are still pursuing a **linear model** of production (“take, make, waste”; Lacy et al., 2015).

focus

One of the key elements in creating a shift into a circular model is **upcycling** wastes and by-products (McDonough et al., 2013).

focus

Particular benefits can be given by the reuse of **organic waste** due to the fact that generates only low further environmental burden in the disposal phase being biodegradable (Lasaridi et al., 2011).

focus

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- 9 times

9 times smaller environmental burden on most of the ISO14040:2006 impact categories during the disposal phase in comparison to non-biodegradable wastes (David et al., 2020).

focus

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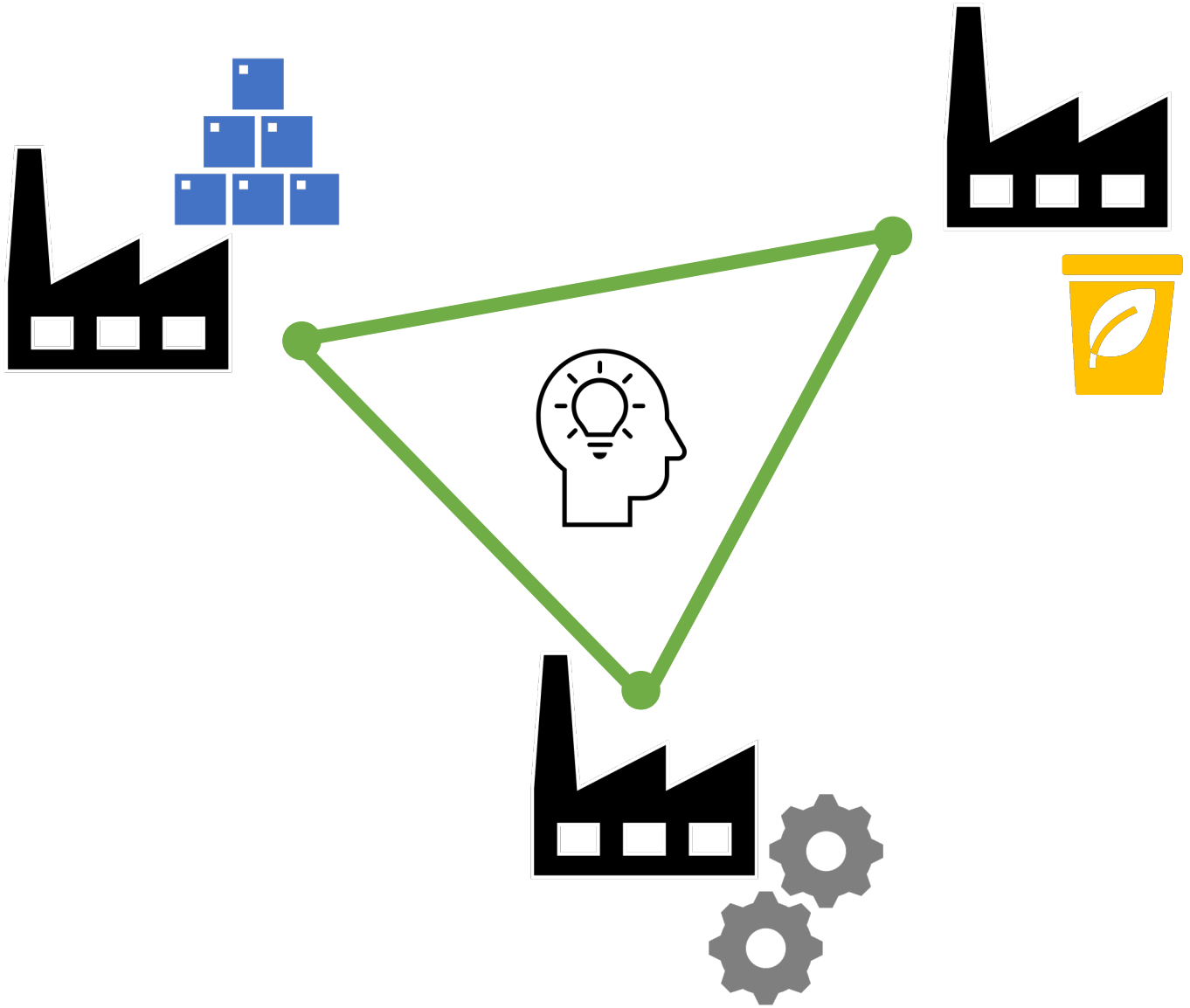
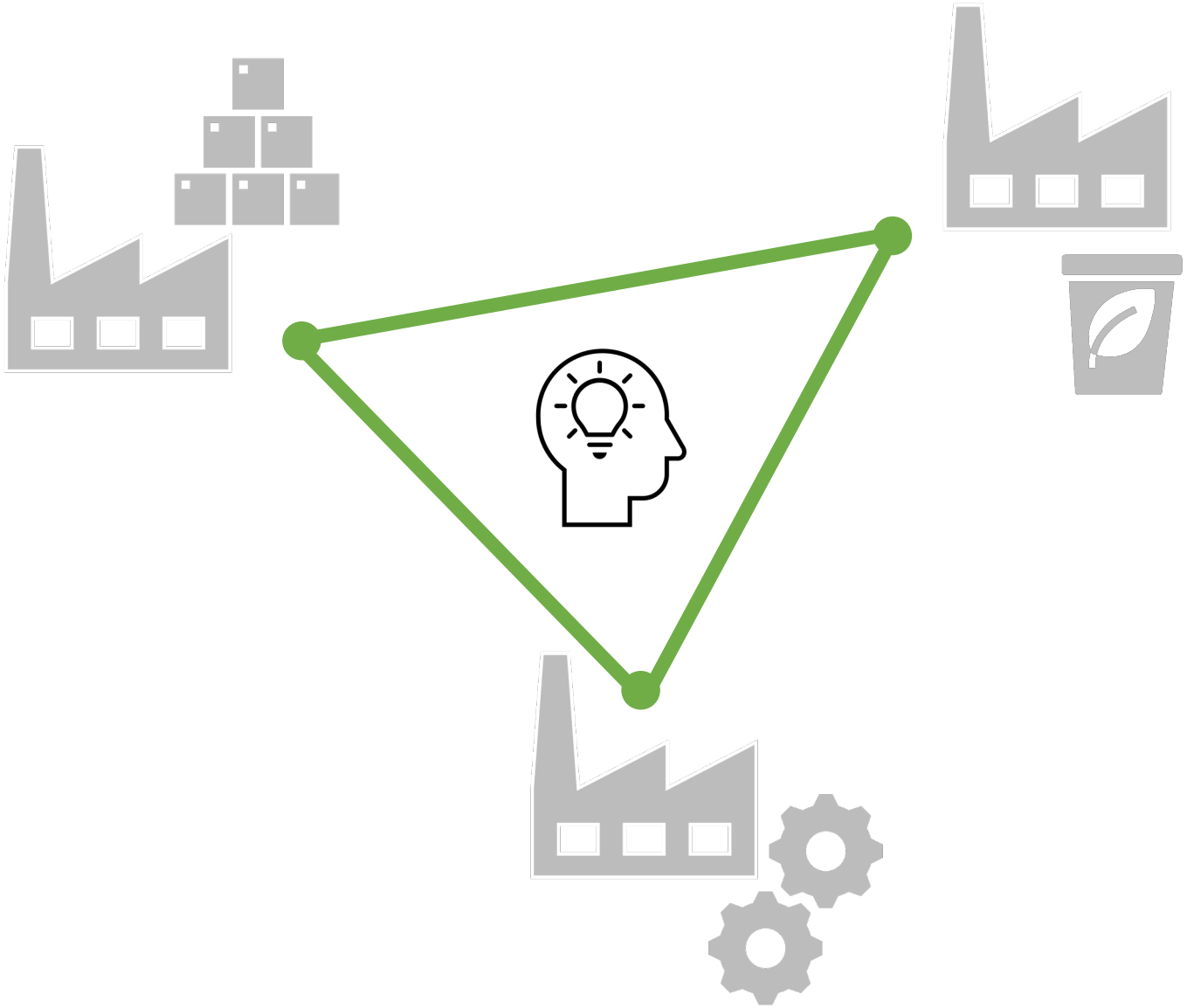


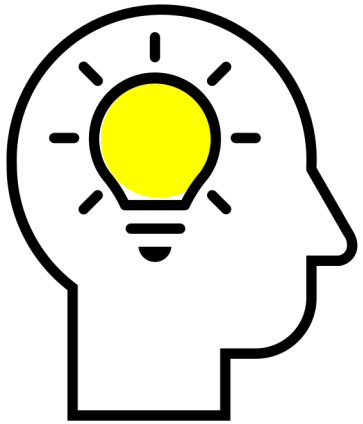
Tangible examples of upcycling can be found in **Industrial Symbiosis** practices, which creates processes enabling upcycling to be **scaled up** making these practice more impactful (Chertow, 2000).

focus



Nowadays, industrial symbiosis evolved assuming more diffused forms (Neves et al., 2020) where **information**, **connections** and **knowledge** become more and more important in facilitating processes and collaborations (Bijon et al., 2022). On this matter, **industrial symbiosis networks** have been considered by Albino et al. (2013) “one of the most effective tools to mitigate the environmental impact of industrial activities”.

focus



It has been studied that up to 80% of the environmental impact of a product is determined in the design phase (Thackara, 2005).

One of the challenges that **designers** are facing today is to redefine their role integrating their work in these new developing systems envisioning the creation of a positive impact.

focus

case studies collection

Year	geographical origin	Designer / brand	Project name	Project output	Type of material developed	organic waste used	Scalability (1-5)	Developed by local stakeholders Yes/No	Intent to produce a social impact Yes/No	Process producing waste	scutching	peeling	drying	grinding	extracting	mixing / compounding	polymerisation	pressing	spreading	extrusion	yarning	dyeing	weaving / non-weaving	moulding	manipulating	coating
2011	Germany	Q MILK	Q MILK	milk fabric	fabric	milk	5	yes	no	milk production					X		X				X					
2012	Cina	Akasith el al.		UV protective edible films from squids for food packaging	bioplastic	squids	1	no	no	fish processing					X		X									
2012	USA	Agraloop	Agraloop	agricultural waste into fabrics	fabric	agricultural fibers	5	no	no	agricultural harvesting					X		X				X					
2013	Italy	Luciana Sartore et al.		agro waste	filler	wastes and by-products of agro-		no	no	agricultural						X								X		
2013	Brazil	Natalia Chaves Bruno and Manuela Yamada	Botià	cocout containers	non-woven textile	coconut	1	no	no	coconut processing	X		X			X				X				X		
2013	Italy	Gionatan Gatto	Agricola	fibers lamps	non-woven textile	fibers from vegetable waste	2	no	no	agricultural harvesting	X					X		X						X		
2014	Philippines	Carmen Hijosa	Pinatex	pineapple leaves leather	leather	pineapple leaves	5	yes	yes	agricultural harvesting	X		X			X			X				X			X
2015	Philippines	Bananatex	Bananatex	banana leaves fabric	fabric	banana plants	5	yes	yes	agricultural harvesting	X		X								X					
2016	UK	Tessa Silva	Feminised Protein	milk proteine made objects	bioplastic	milk	1	no	no	household waste						X	X							X		
2017	Poland	Sonia Jaskiewicz	Waste lab	materials from sugar beet leaves	non-woven textile	sugar beet leaves	1	no	no	agricultural harvesting	X		X			X							X			
2018	UK	Oskar Metsavaht	Piracucu leather	pirarucu fish skin bags	leather	pirarucu fish skin	5	no	no	fish		X										X				

About **300 case studies** have been collected including designers and brands developing **organic waste deriving DIY-materials**.
The selected case studies have different apporaches: some of them worked on novel **DIY materials drafts concepts**, others implemented the realised materials into unique or replicable **design outputs**, while others tackled organic waste streams with the intent to develop novel **industrial symbiosis** practices

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2012	Cina	Akasith el al.		UV protective edible films from squids for food packaging	bioplastic	squids	1	no	no	fish processing					X		X									
2012	USA	Agraloop	Agraloop	agricultural waste into fabrics	fabric	agricultural fibers	5	no	no	agricultural harvesting					X		X				X					
2013	Italy	Luciana Sartore et al.		agro waste biodegradable pots	filler	wastes and by-products of agro-food industries and paper–textile	3	no	no	agricultural harvesting			X	X		X								X		
2013	Brazil	Natalia Chaves Bruno and Manuela Yamada	Botià	cocout containers	non-woven textile	coconut	1	no	no	coconut processing	X		X			X				X				X		
2013	Italy	Gionatan Gatto	Agricola	fibers lamps	non-woven textile	fibers from vegetable waste	2	no	no	agricultural harvesting	X					X		X						X		
2014	Philippines	Carmen Hijosa	Pinatex	pineapple leaves leather	leather	pineapple leaves	5	yes	yes	agricultural harvesting	X		X			X			X				X			X
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2017	Poland	Sonia Jaskiewicz	Waste lab	materials from sugar beet leaves	non-woven textile	sugar beet leaves	1	no	no	agricultural harvesting	X		X			X							X			
2018	UK	Oskar Metsavaht	Piracucu leather	pirarucu fish skin bags and dresses	leather	pirarucu fish skin	5	no	no	fish processing		X										X				

case studies collection

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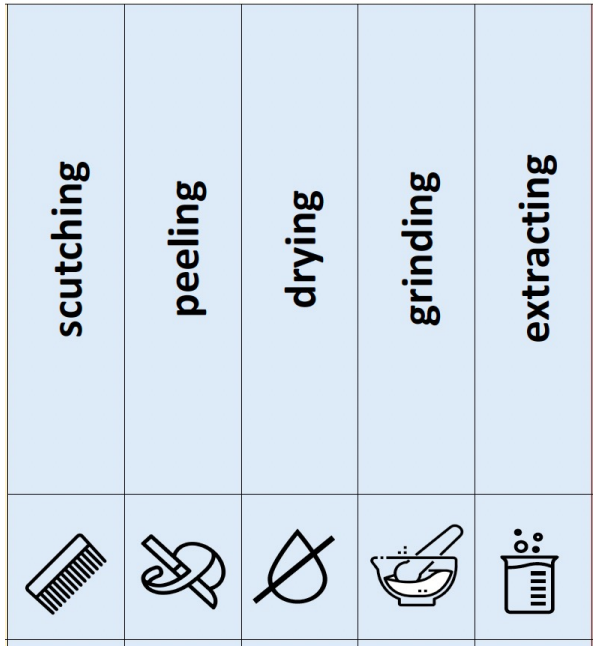
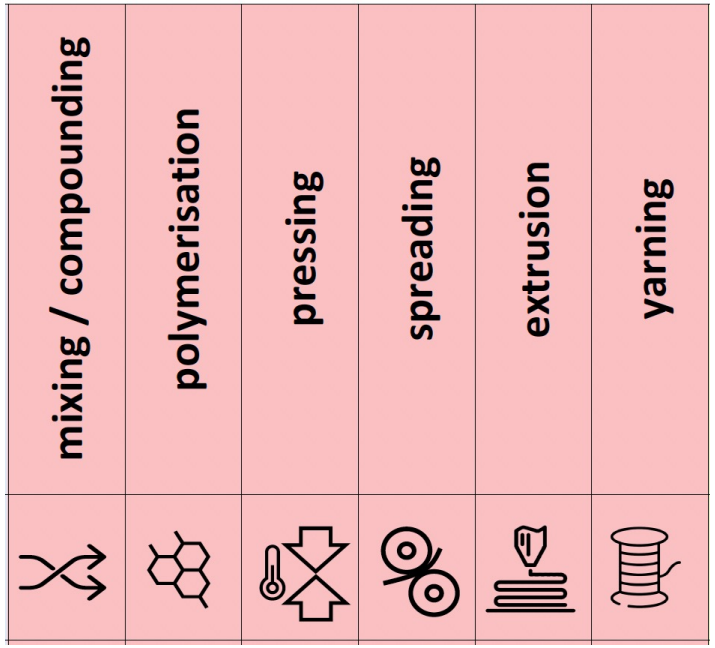


Type of processes used to transform the organic waste:

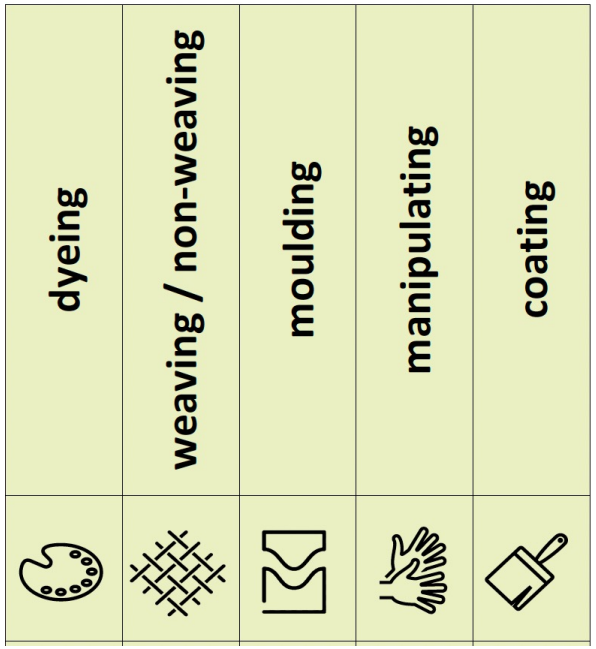
five generic processes found in common between the multiple case studies necessaries to make organic waste usable in the following phases



Type of process used to realise the organic deriving materials:

six generic processes used in the collected case studies to realise the organic waste deriving materials

case studies collection



Type of processes used to realise different design outputs made with the organic deriving materials:

five generic processes found in common between the the

Organic waste deriving DIY materials

Through manipulating ”matter”, the new generation designers are starting to develop inspiring and inventive **DIY materials drafts** able to question multiple organic waste streams proposing inventive concepts and sustainable solutions (Rognoli et al., 2015)

Organic waste → **DIY materials**

case studies

Project name: *Sustrato*, 2019

Designers: Andrea De La Peñaa

Organic waste used: pineapple leaf fibres

Process producing waste: agricultural harvesting

Developed material: non-woven leather-like materials, yarn

Description: mix DIY ancient extraction techniques with modern technology. Four different proposals: rope, bioplastic, felt and an agglomerated material.

case studies

Project name: *Bioplastic skin*, 2019

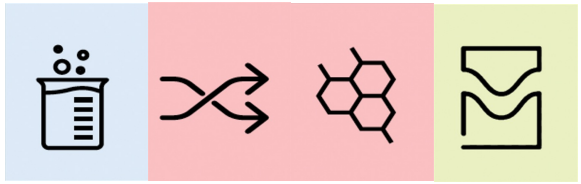
Designers: Valdís Steinars

Organic waste used: animal skin collagen

Process producing waste: animal slaughtering

Developed material: bioplastic

Description: aiming to reduce the use of plastic in the food industry, in particular the meat industry. We need to look no further than the skin of the animal itself



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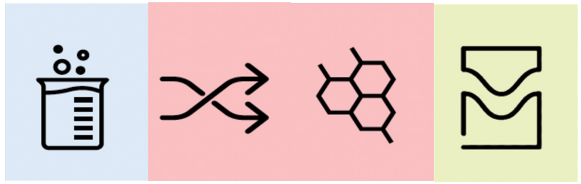

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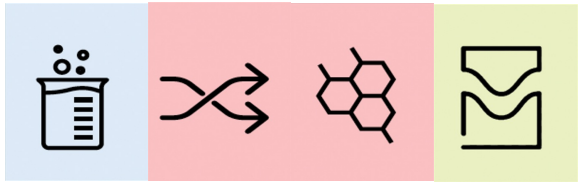


case studies

Project name: *Eggshell ceramic*, 2020

Designers: Atelier Lvdw

Organic waste used: eggshell

Process producing waste: Industrial food processing

Developed material: bioplastic

Description: eggshells which can be a sustainable replacement for single use plates. The material has the look of ceramics but the weight of cardboard, which makes it a versatile material

case studies

Project name: *Hidden Beauty*, 2019

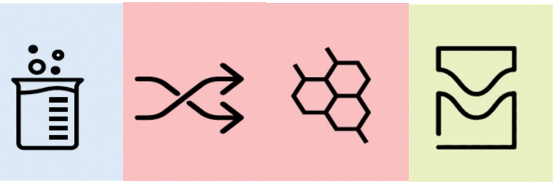
Designers: Clemence Grouin-Rigaux

Organic waste used: cow blood

Process producing waste: animal slaughtering

Developed material: bioplastic

Description: Blood is one the most diffused FLW produced by the slaughtering industries, and designers started to work with it discovering its potential to be used as biopolymer and pigment



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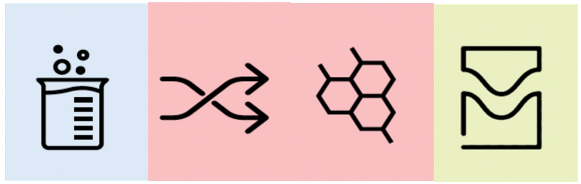

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Description: Blood is one the most diffused FLW produced by the slaughtering industries, and designers started to work with it discovering its potential to be used as biopolymer and pigment

case studies

Project name: *Jelly Joint,* 2019

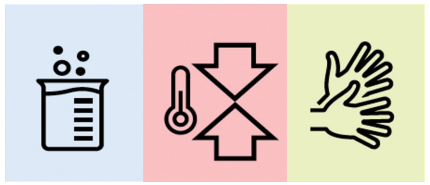
Designers: Philipp Hainke

Organic waste used: expired gummy bears

Process producing waste: household waste disposal

Developed material: bioplastic

Description: It all started with an open and playful research into the modification of sweets and candy. The sweats have been melted, frozen, expended and recomposed. It turned out that the Gummy Bears turn super sticky when heated.



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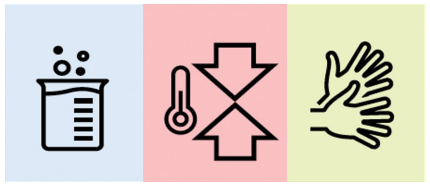

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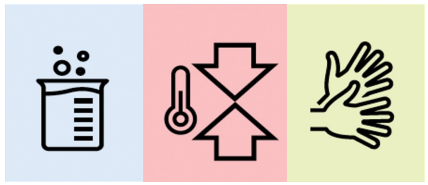

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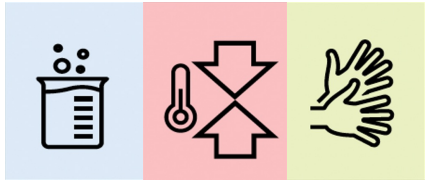


case studies

Project name: *Re.Bean,* 2019

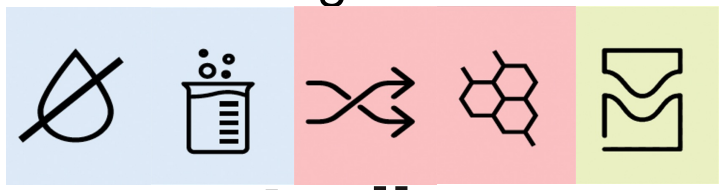
Designers: Kristen Wang

Organic waste used: spent coffee + casein

Process producing waste: catering food sector waste

Developed material: bioplastic + filler

Description: made from locally collected coffee ground waste, Re.Bean Coffee Project explores the unique smell, tactile and formation of this new sustainable material, and it also proves to be 100% biodegradable.



case studies

Project name: *Peel Saver,* 2019

Designers: Paolo Stefano Gentile

Organic waste used: potato peel

Process producing waste: catering food sector waste

Developed material: paper

Description: single use French fries holder usable for street food, biodegradable and completely edible.

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case studies

From organic waste deriving DIY materials to design outputs

Following, a series of case studies of designers realising organic waste deriving DIY materials and implementing them in multiple **design outputs,** often founding startups or transforming them in artisanal products.

Organic waste deriving DIY materials → **design outputs**

case studies

Project name: *Indianes*, 2020

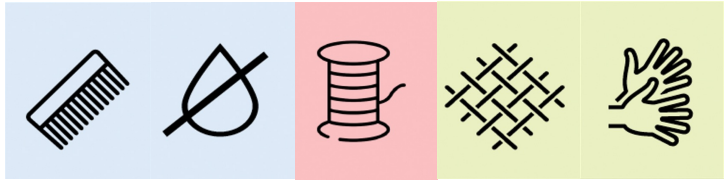
Designers: Diana Feliu and Iván Rojas

Organic waste used: banana stem fibres

Process producing waste : agricultural harvesting

Developed material: fabric

Description: banana stem fibres made shoes. They cooperated with 60 artisans using traditional techniques, part of the local indigenous communities in the Andes mountain.



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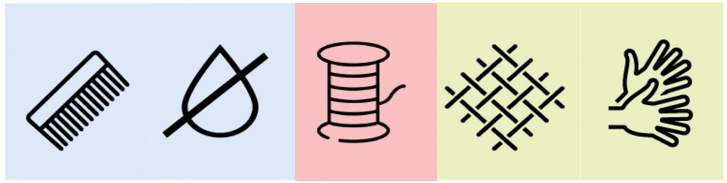

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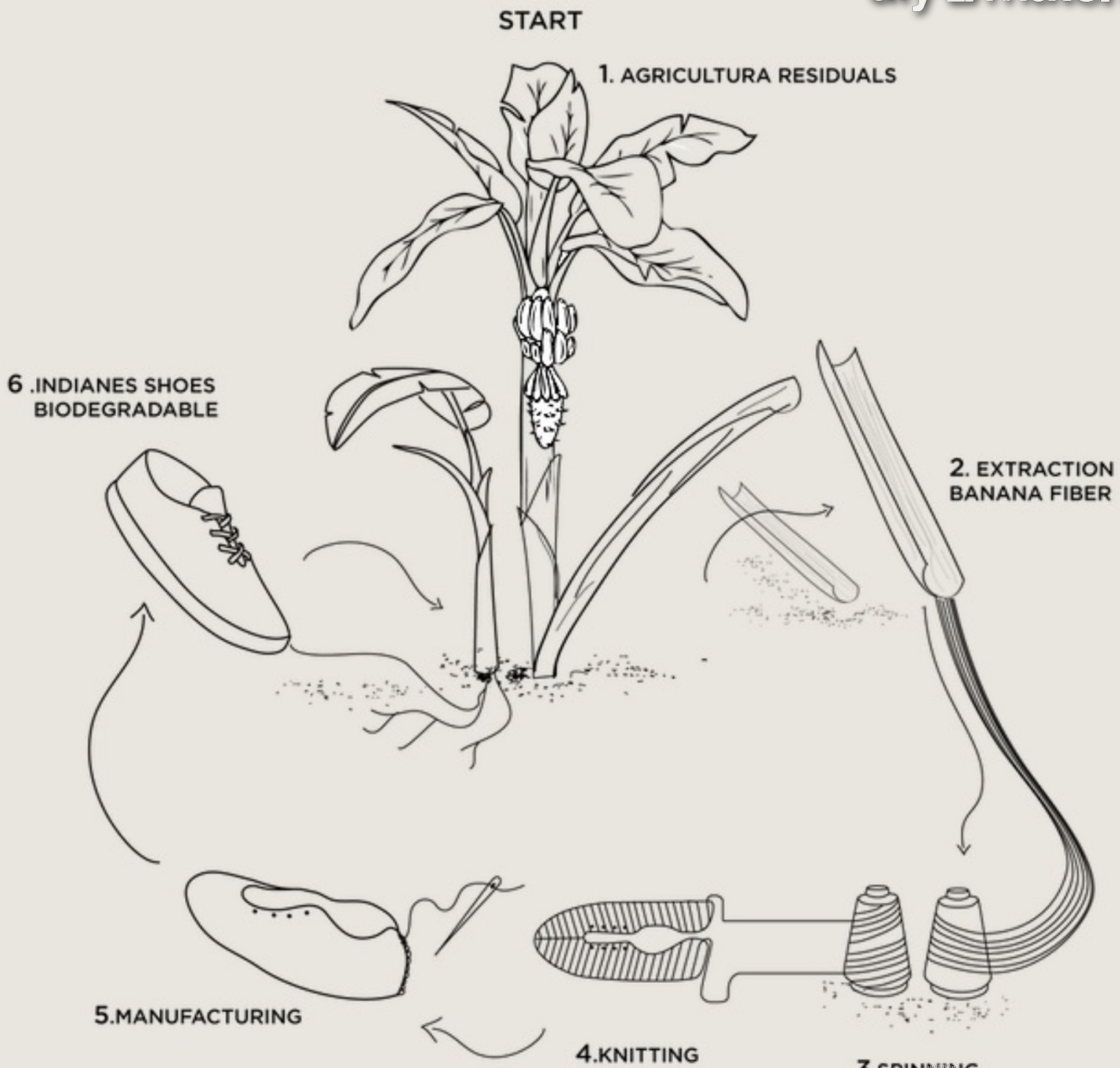

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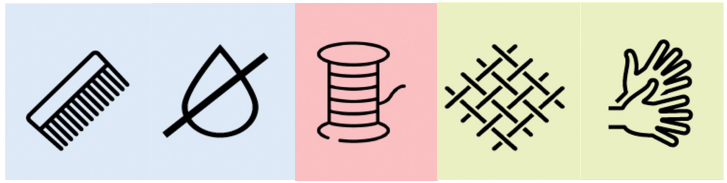

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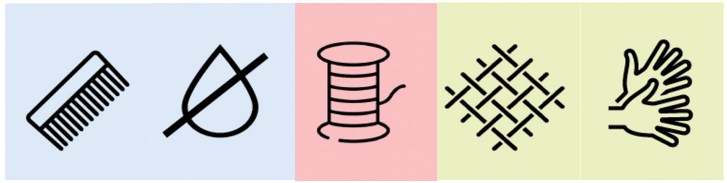

case studies

Project name: *Nebula*, 2019

Designers: Studio Mirei

Organic waste used: banana leaf

Process producing waste: agricultural harvesting

Developed material: fabric

Description: natural fabric from banana leaves to realise products, such as chandeliers and table lamps. The textiles she uses are crafted by small artisans communities in the Philippines.

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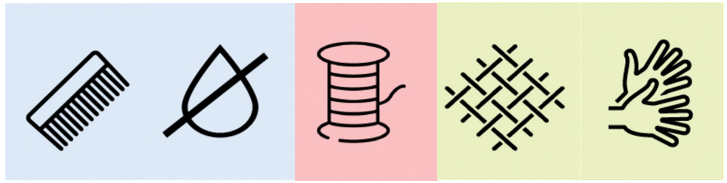

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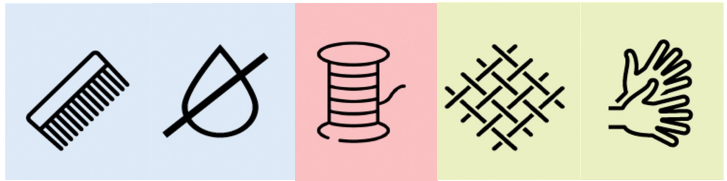


case studies

Project name: *Tomotextle*, 2018

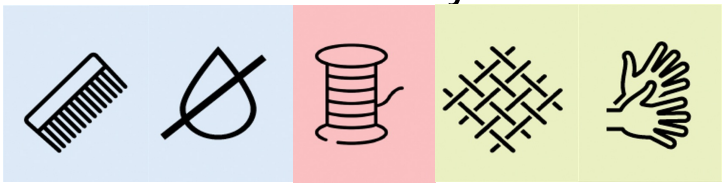
Designers: Fernando Laposse

Organic waste used: Corn leave

Process producing waste: agricultural harvesting

Developed material: veneer

Description: Totomoxtle is a new veneer material made with husks of heirloom Mexican corn. It showcases the wealth of diversity of the native corns of Mexico creating a new craft that generates income for impoverished farmers and promotes the preservation of biodiversity for future food security.



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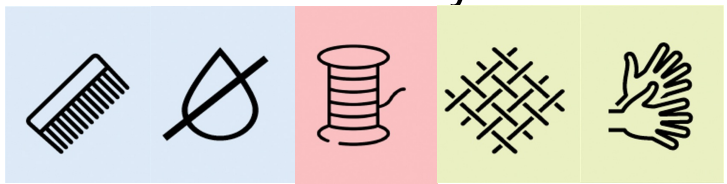

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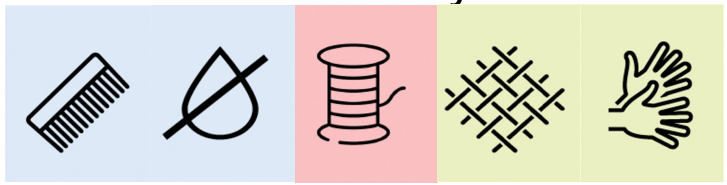

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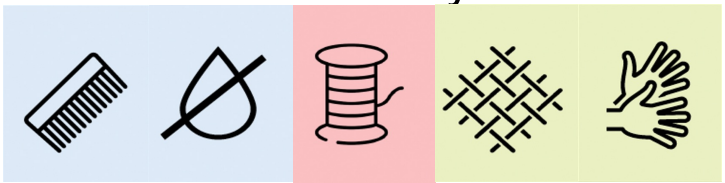

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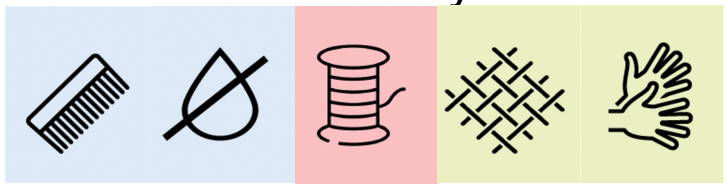


case studies

Project name: artichokes
packaging, 2018

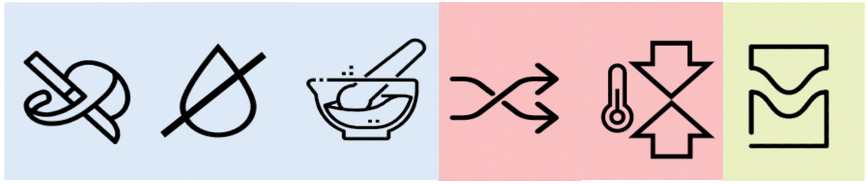
Designers: Smart Materials Lab from the Istituto Italiano di Tecnologia (IIT)

Organic waste used: artichokes leftovers

Process producing waste : vegetable peeling

Developed material: bioplastic

Description: a bioplastic packaging for fruit and vegetables obtained from the fibrous waste of artichokes, born from a collaboration at 0 Km with Società Gestione Mercato di Genova



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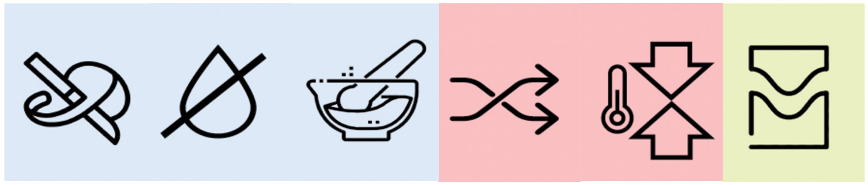


case studies

Project name: *Koji 26,* 2015

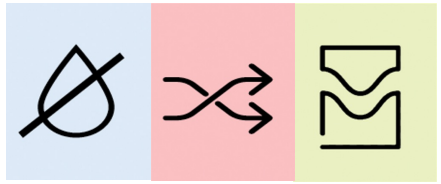
Designers: Decafè

Organic waste used: spent coffee

Process producing waste: catering food sector waste

Developed material: filler

Description: Its light colour and smell when lit will take you back to a particular moment when you were relaxing with a nice cup of coffee, and its interior stands out with the exterior creating a beautiful interplay of light and colour



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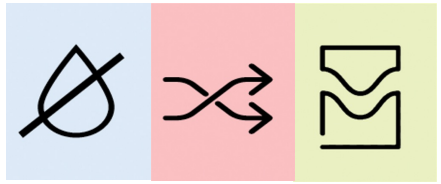

case studies

Project name: *Scoby Packaging Materials, 2019*

Designers: MakeGrowLab

Organic waste used: kombucha scoby

Process producing waste: Kombucha tea making

Developed material: bioplastic

Description: this form of pure cellulose has unique features that do not require petroleum-based additives and other nonbiodegradable and toxic substances.

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case studies

Project name: *MarinaTex,* 2020

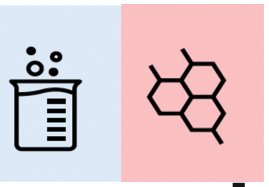
Designers: Lucy Huges

Organic waste used: fish scales

Process producing waste: industrial fish processing

Developed material: bioplastic

Description: bags to single-use packaging, MarinaTex has a variety of different applications. The transparent film is well suited for packaging and will biodegrade in a soil environment. The organic formula does not leach harmful chemical.



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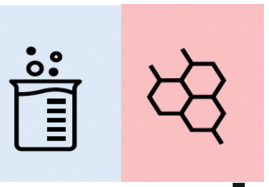

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case studies

Project name: *AuReus,* 2020

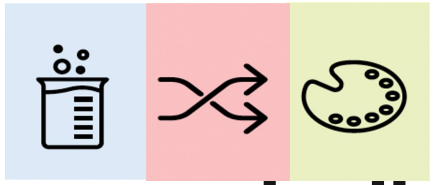
Designers: Carvey Ehren Maigue

Organic waste used: household vegetal leftovers

Process producing waste: vegetable waste sorting

Developed material: pigment + polymer

Description: developed a compound made out of new material from vegetable leftovers which converts UV light into renewable energy having a wide range of applications, from windows to building facades



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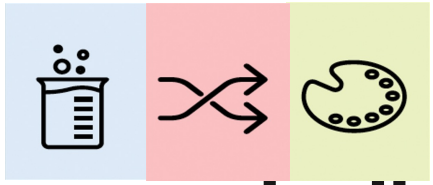

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POLITECNICO MILANO 1863

Project name: *Color Amazonia,* 2020

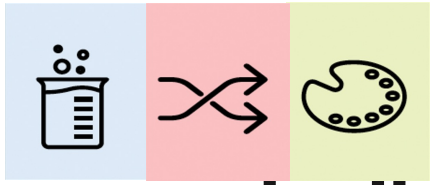
Designers: Susana Mejía

Organic waste used: amazonian plants disposed during deforestation

Process producing waste: deforestation

Developed material: pigments

Description: thanks to the ancestral knowledge of Huitoto and Tikuna communities, eleven botanical species and the processes have been restored. Color is a pretext to exalt the immense value of a jungle that is disappearing.



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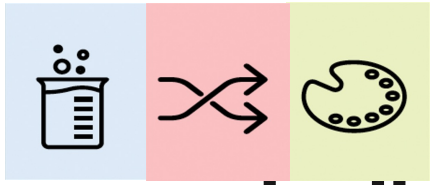

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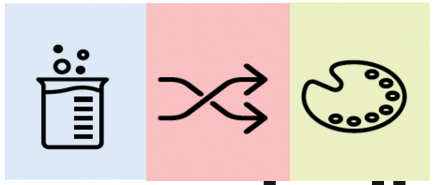

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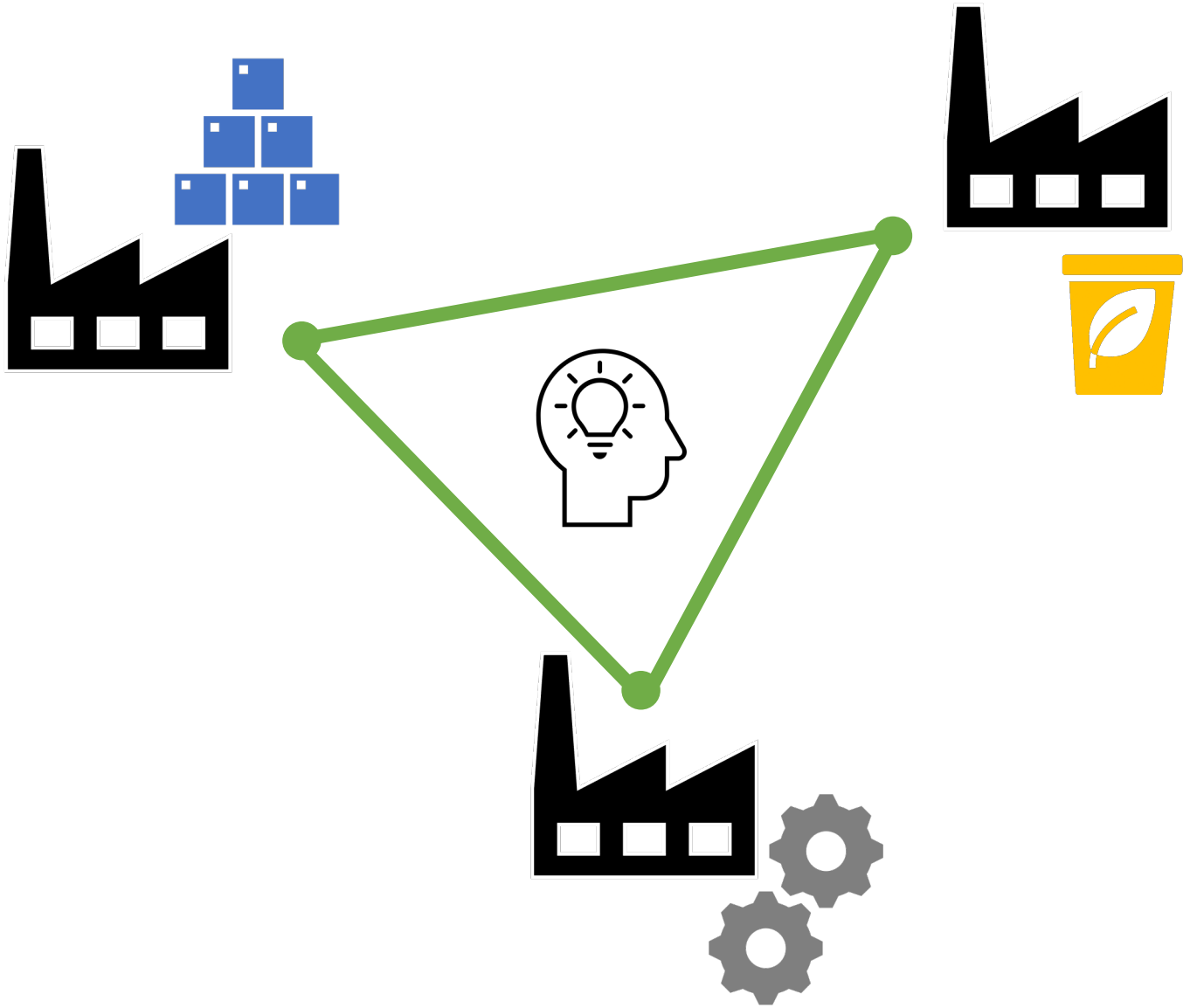
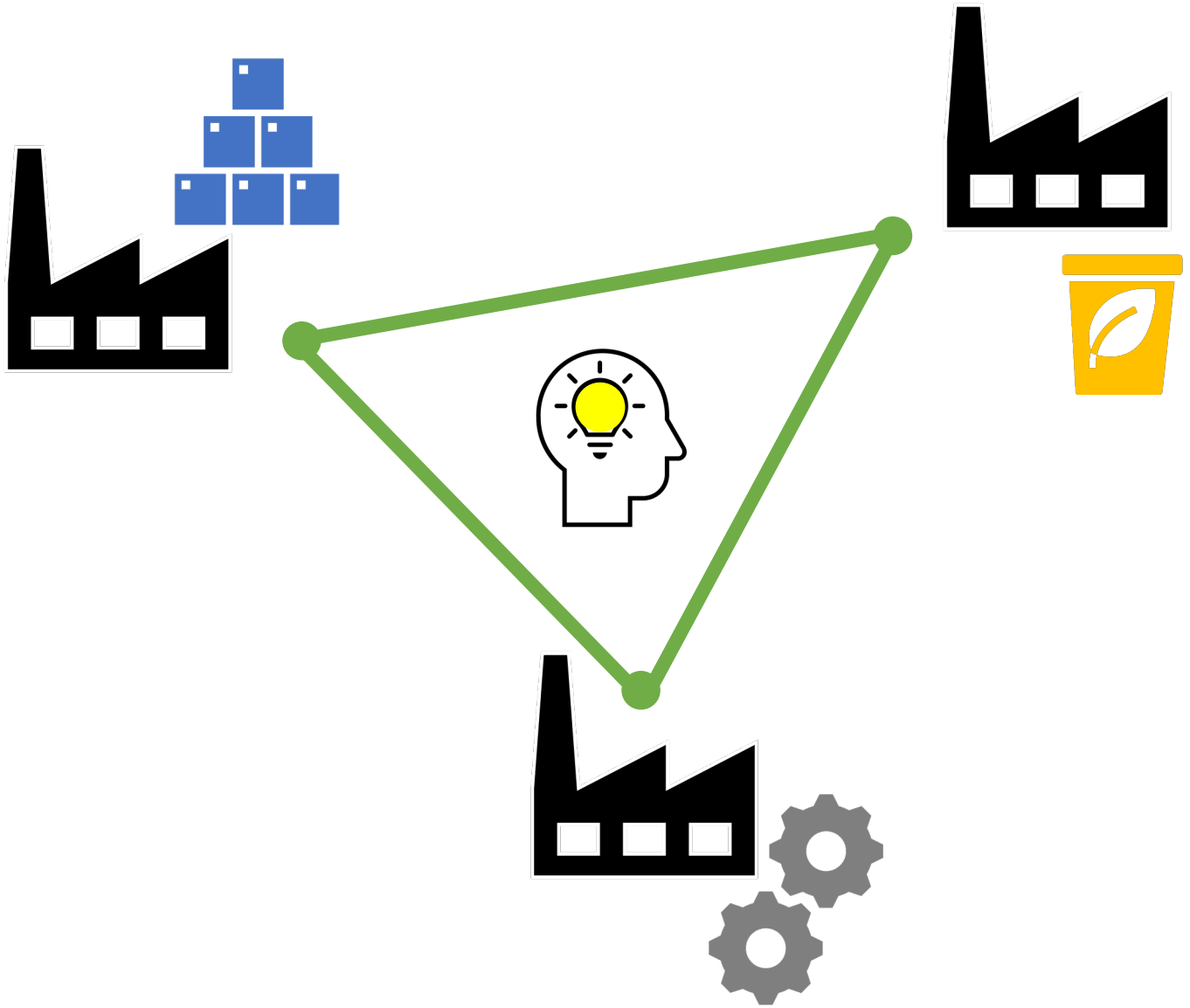


From organic waste deriving DIY materials to industrial symbiosis practices

Following, a series of case studies implying designers able to connect multiple stakeholders and to re-design supply chains creating novel forms of **industrial symbiosis practices**

Organic waste deriving DIY materials → **Industrial symbiosis practices**

case studies



The following case studies include designers, starting to work **from DIY materials** and tackling waste streams with the intent to **create novel supply chains** where multiple stakeholder started to collaborate creating novel materials and products.

Part of my work as researcher, is to identify new **models** facilitating the new generations of designers to identify, mapping and foster the development of **new industrial symbiosis networks through the creation of novel materials**.

case studies

Project name: *Orange Fibers*, 2014

Designers: Adriana Santanocito and Enrica Arena

Organic waste used: orange peel

Process producing waste: orange juice making

Developed material: yarn

Description: orange leftovers to create a new textile that, being mixed with silk, has been used by major fashion brands such as Salvatore Ferragamo and E. Marinella

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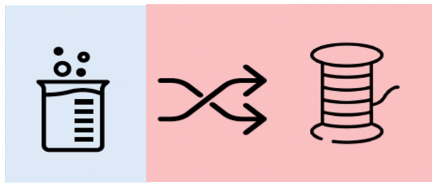

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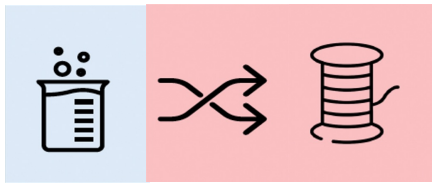
Description: orange leftovers to create a new textile that, being mixed with silk, has been used by major fashion brands such as Salvatore Ferragamo and E. Marinella



case studies

Project name: *Orange Fibers*, 2014

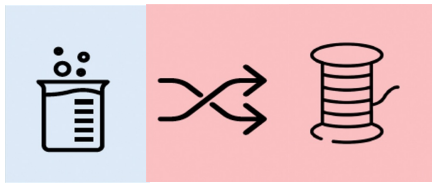
Designers: Adriana Santanocito and Enrica Arena

Organic waste used: orange peel

FSC phase: Industrial food processing

Developed material: yarn

Description: orange leftovers to create a new textile that, being mixed with silk, has been used by major fashion brands such as Salvatore Ferragamo and E. Marinella



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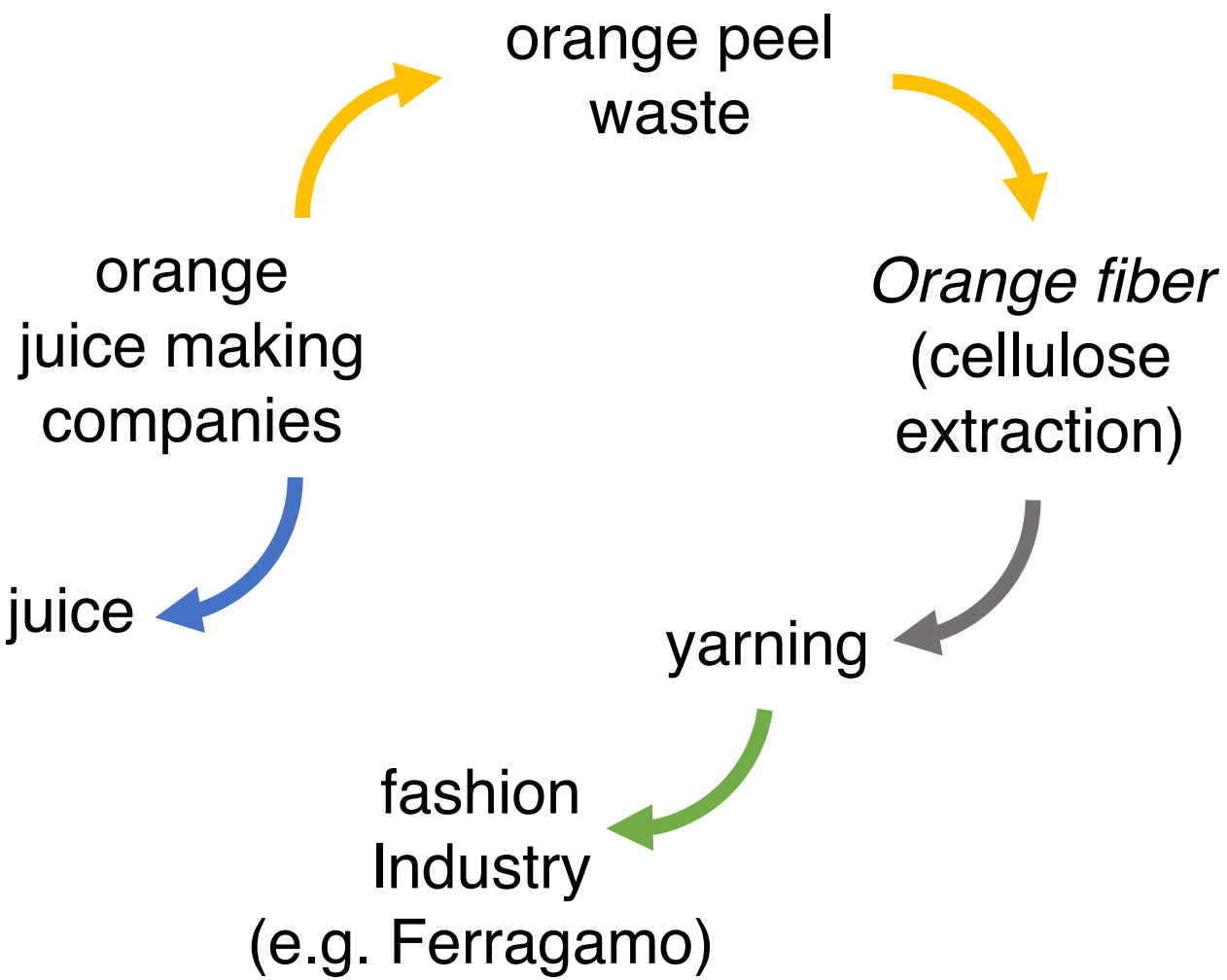

Project name: *Rice House*

Designers: Tiziana Monterisi and Alessio Colombo

<u>Partially</u> organic waste used: rice husks + rice straw

Process producing waste: rise harvesting and processing

Developed material: filler

Description: s big part of the waste produced along de supply chain of rice is burn, while here is has bee used as filler in multiple construction products, such as paint, insulating pads and pavements.

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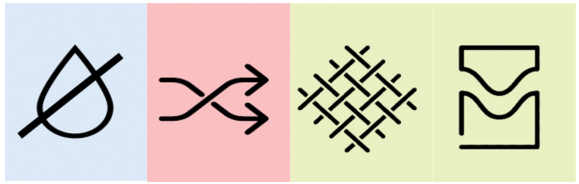

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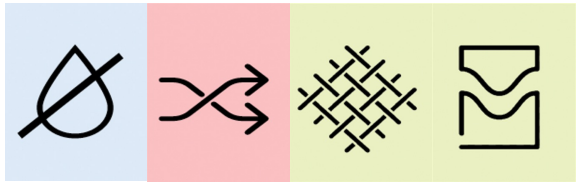

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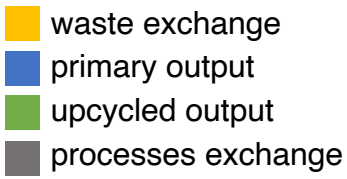

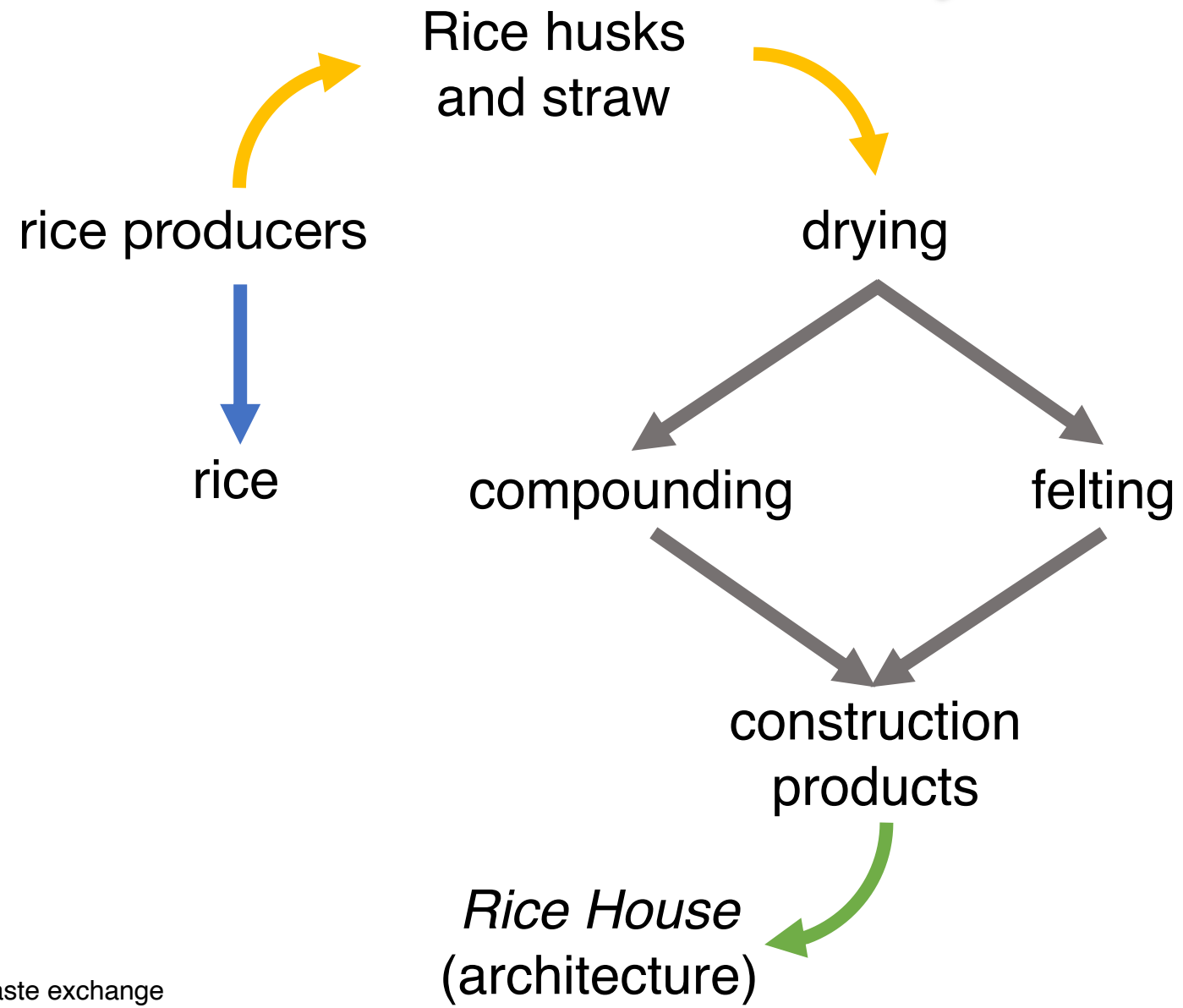

Project name: *Trebodur,* 2020

Designers:
Niko Stoll & Tillmann Schrempf

Organic waste used: spent grain from beer making

Process producing waste: beer making

Developed material: bioplastic

Description: bound by the natural amount of proteins in brewers' spent grain. No additional binders are added. Brewers' spent grains are the residues that accumulate from barley malt during the process of lautering while producing beer.

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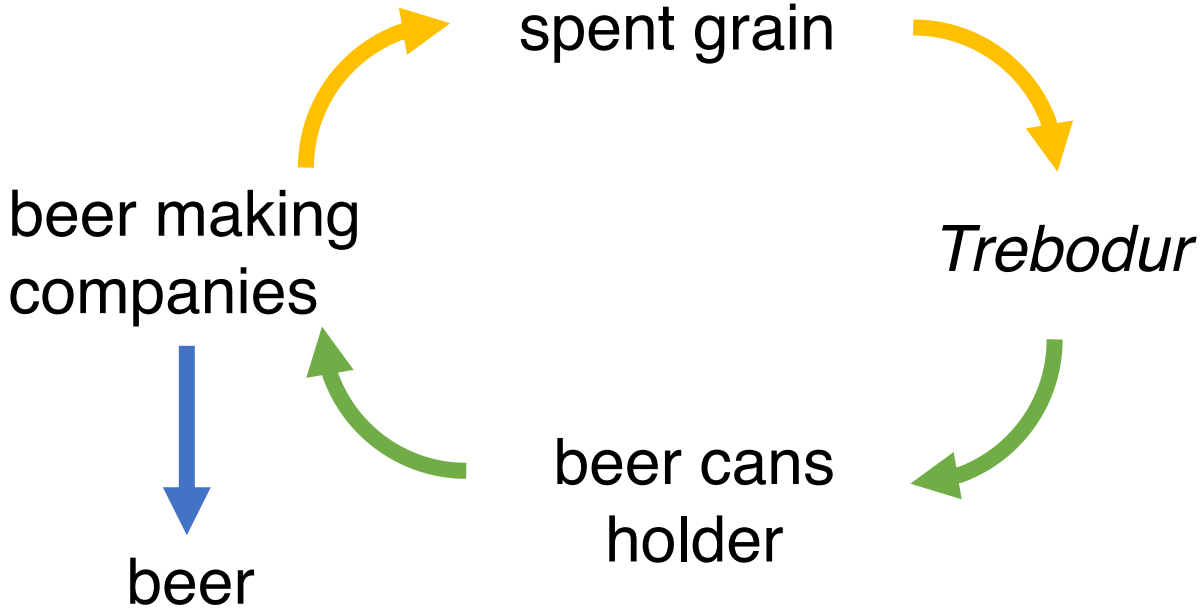


waste exchange
primary output
upcycled output
processes exchange

case studies

Project name: *Ohmie,* 2021

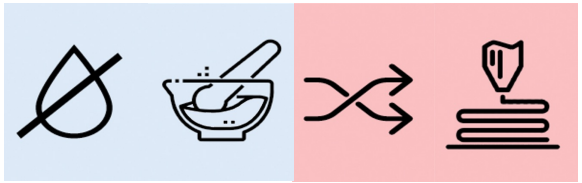
Designers: Krill Design

Organic waste used: orange peel waste

Process producing waste: orange juice making

Developed material: filler

Description: patented innovative bio-material, generated from orange peels and 3D printed in the shape of a desk lamp



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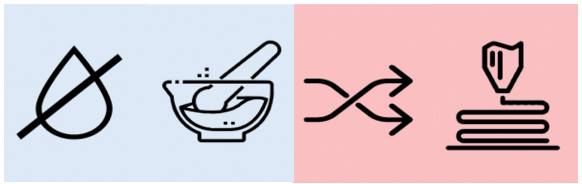

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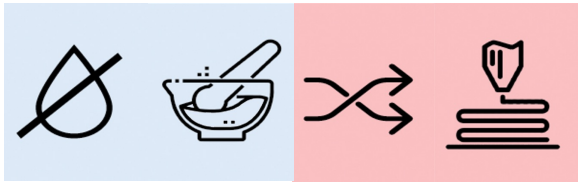

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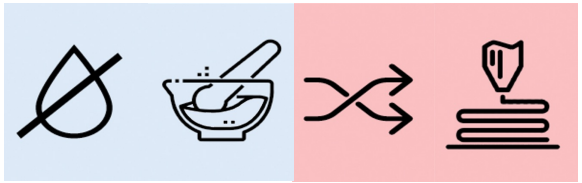

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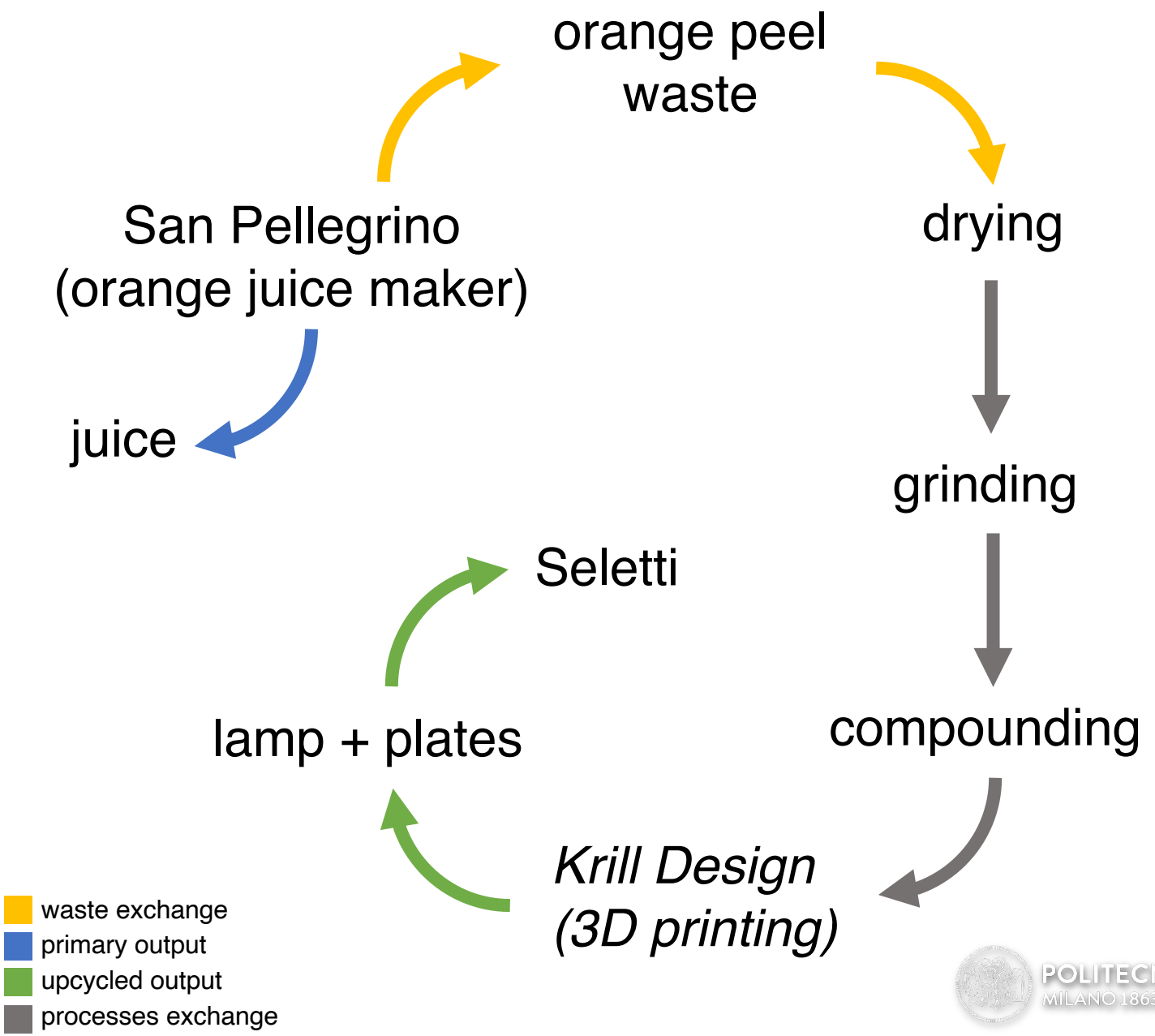


Project name: *Chewing gum wheels, 2021*

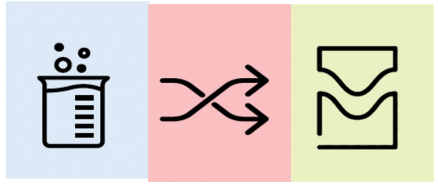
Designers: Hugo Maupetit and Vivian Fischer

<u>Partially</u> organic waste used: chewing gums

Process producing waste: chewing gum throwing

Developed material: polymer

Description: developed a method for collecting discarded chewing gum and turning it into colourful, recycled plastic skateboard wheels. In collaboration with Vans and Mentos



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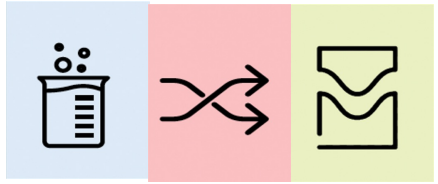

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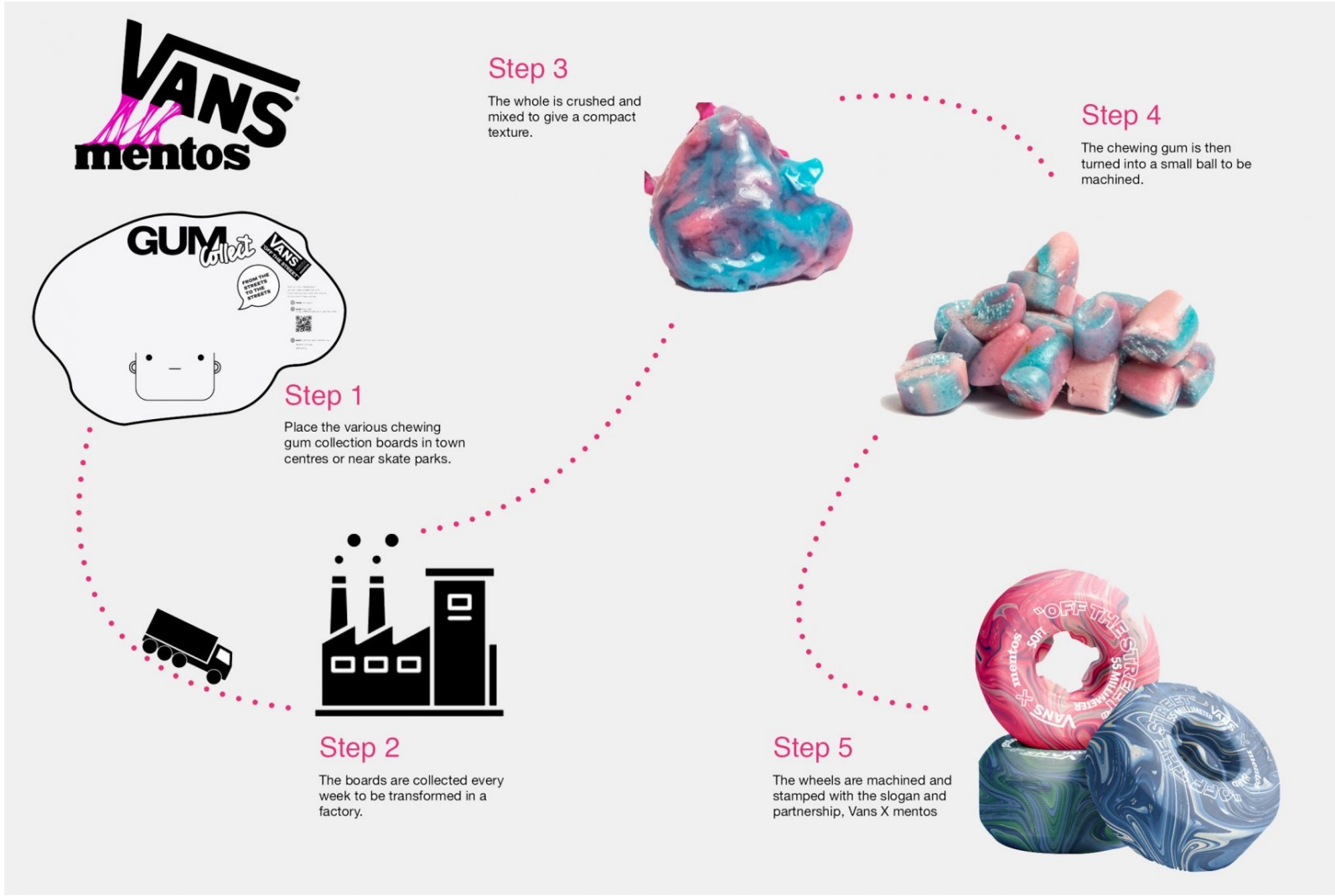

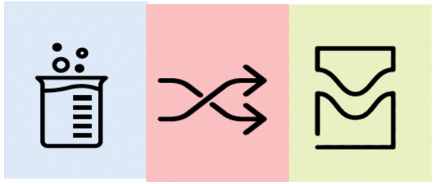

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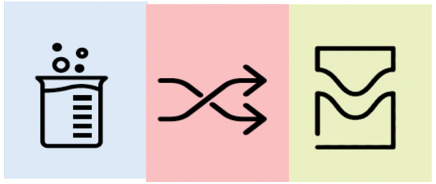

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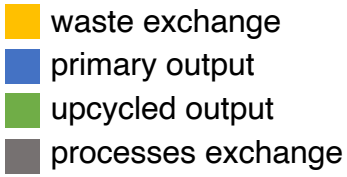

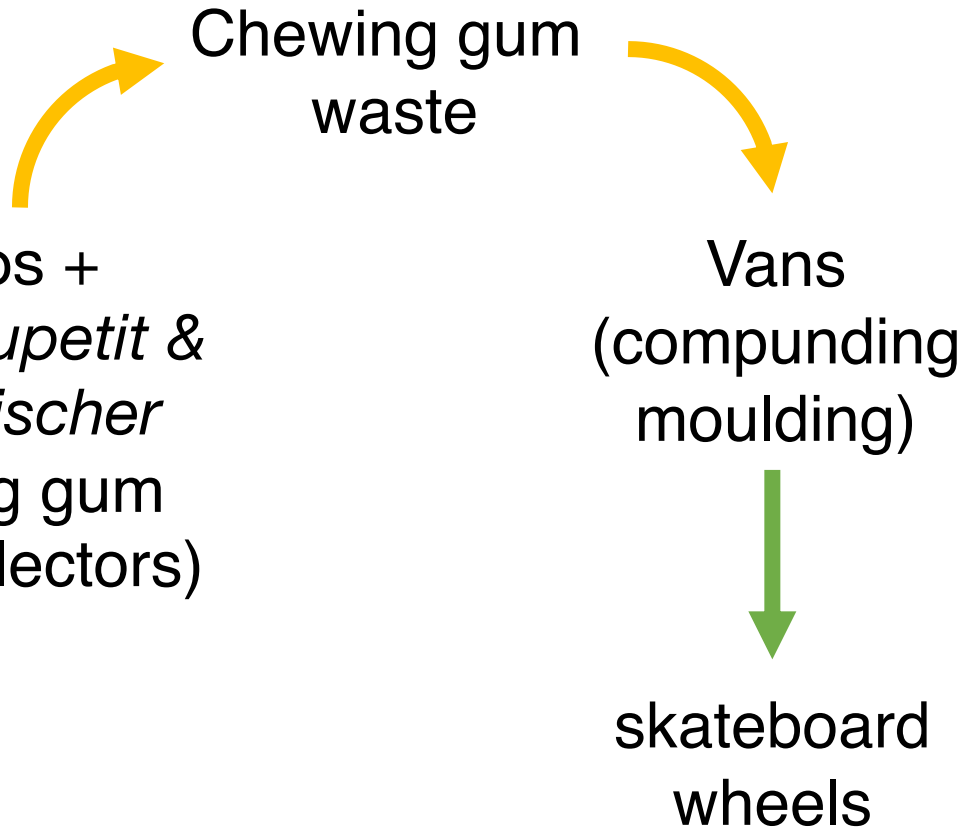

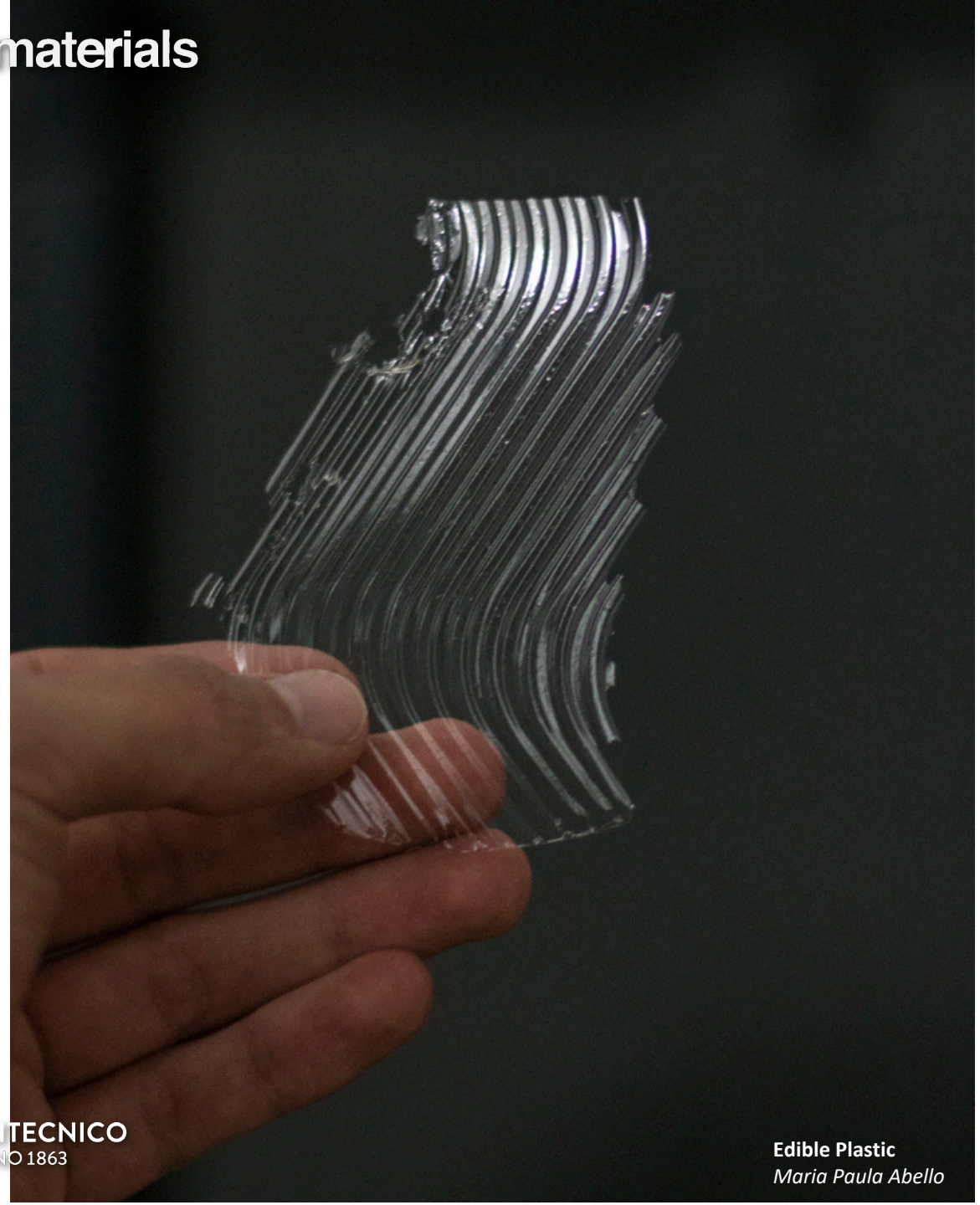

Edible Plastic
Maria Paula Abello

What might be the **role of contemporary and future designers** working with materials?

perspectives

Hexapa
Malen Coñuel

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At the moment, we are collecting case studies and examples of **practitioners looking beyond products and materials** seeking to design the whole supply chain behind them.

perspectives

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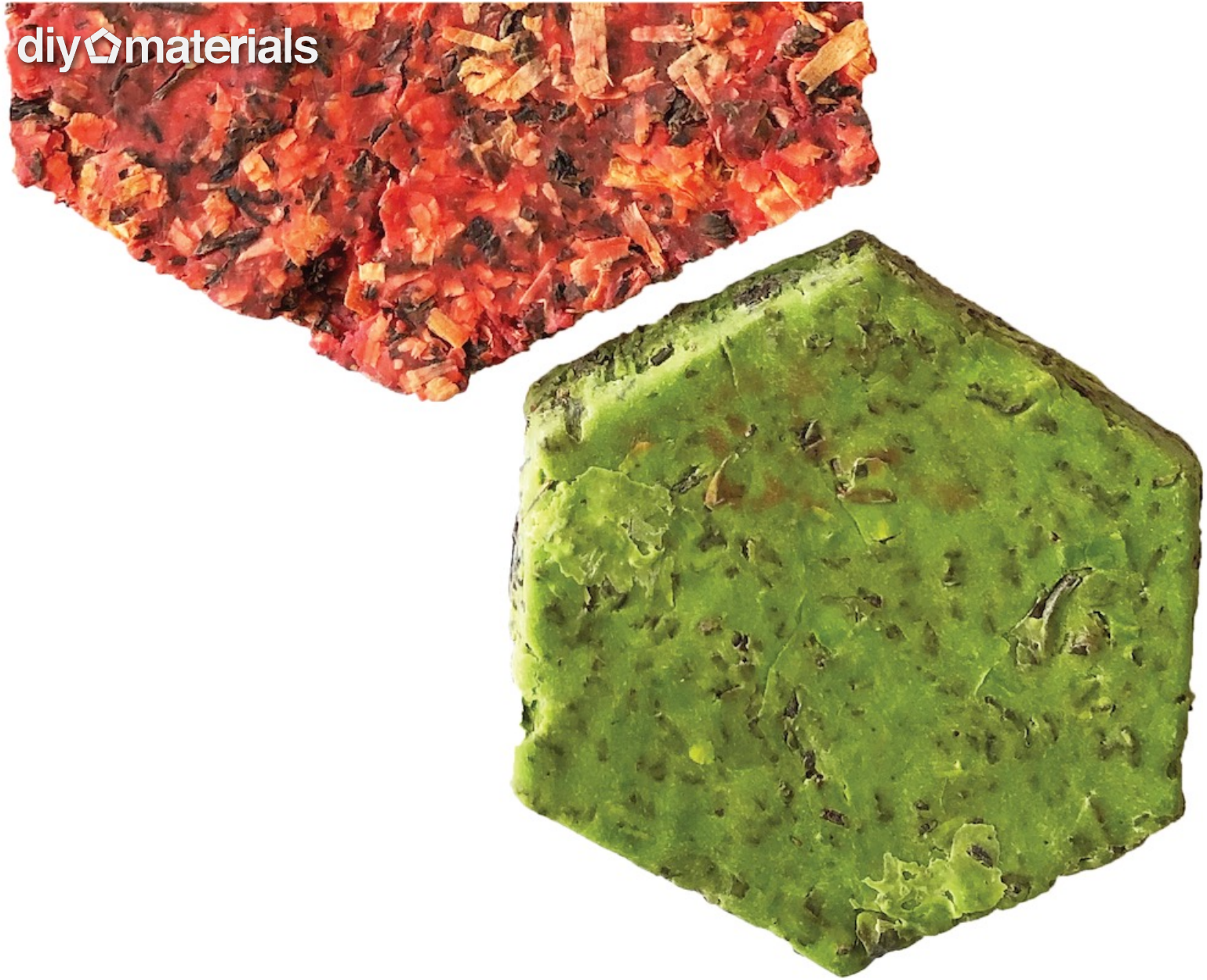
In this way, designers acquire a role enabling them to be the **connectors of the stakeholders** involved in the whole production process (Unal et al., 2019; Urbinati et al., 2017).

perspectives



Crear-Té
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In this way, designers acquire a role enabling them to be the **connectors of the stakeholders** involved in the whole production process (Unal et al., 2019; Urbinati et al., 2017).

This shift allows designers to **expand their competencies**, to **think beyond aesthetics** and to get an **aware perspective** of their huge environmental impact (80%) (Pizzi et al., 2022).

perspectives

diy materials

POLITECNICO
MILANO 1863

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