

Format for the lesson

1. Assignment

Title of the lesson: Plants in our economy – Why things are done in that way?

2. Description

In this lesson, we decipher our relationship with plants depending on the social, environmental and economical context.

To that end, we answer the following questions:

- Why do we need plants?
- Why can plants meet our needs in a sustainable way?
- Why are plants a „super resource“ for our economy?
- Why do we modify the plants we use?
- Why are our modifications on plants necessary?
- Why are our improvements on plants criticised?

3. Used materials (optional)

- Industrially used plants: crops, tomato, tobacco, medicinal plants...
- Bio-based products: examples can be found at <https://www.biobasedconsultancy.com/en/database>
- Exhibition: Bioeconomy in everyday life (www.biocom.de)
- Catalog of the exhibition “Bioökonomie im Alltag” (BioSC, 2016) – BIOCOM AG, www.biocom.de)
- Newspapers´ articles on population growth, climate change, arable land reduction, resource scarcity, demonstrations against GMO...

4. Level of education: Secondary school

Until 40 pupils can work at the lesson.

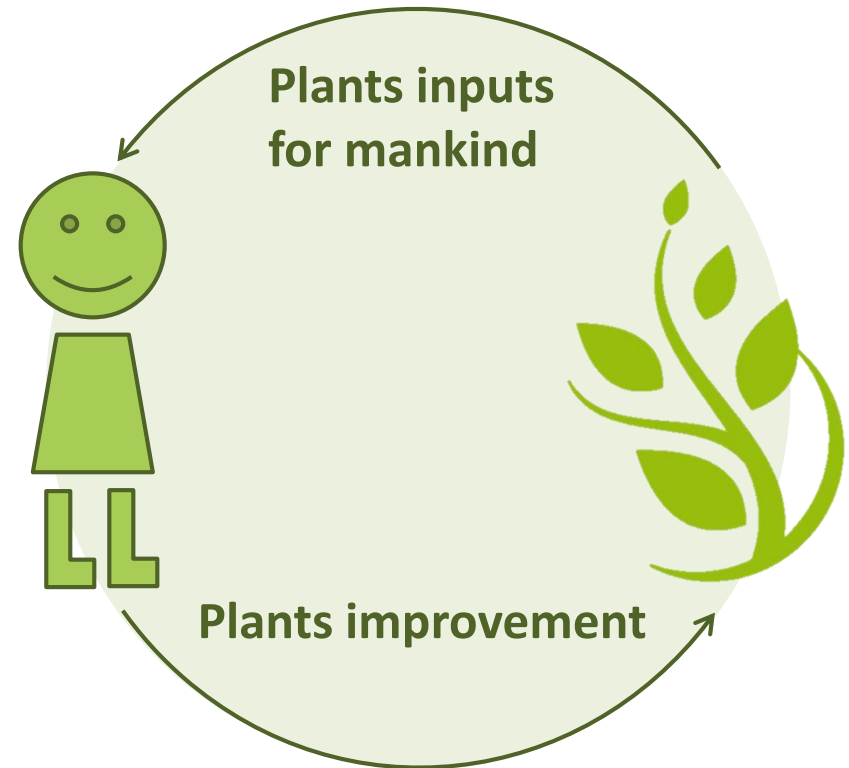
Plants in our economy – **Why** things are done in that way?



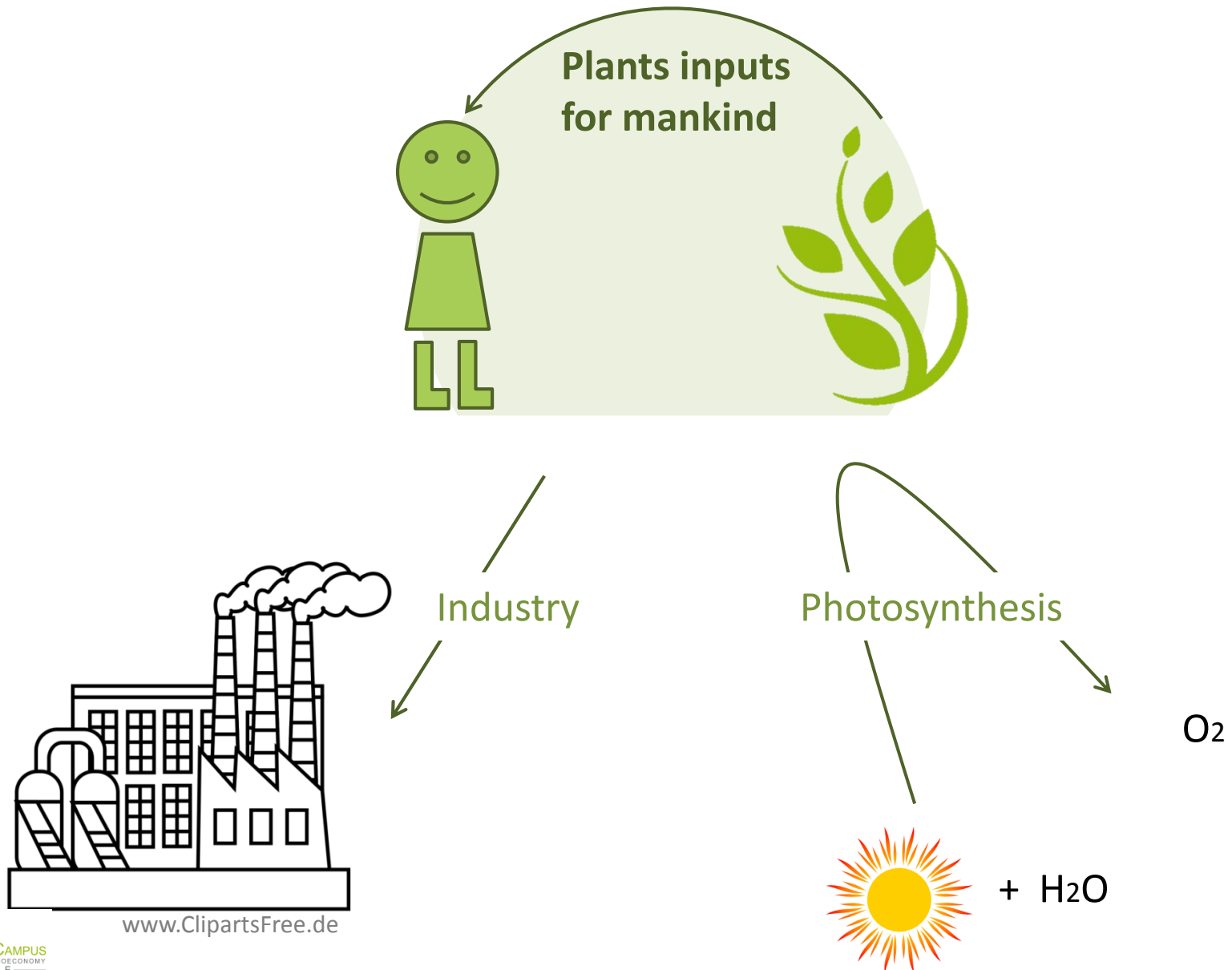
Paul Herzig

Plants in our economy – Why things are done in that way?

1. **Why** do we need plants?
2. **Why** can plants meet our needs in a sustainable way?
3. **Why** are plants a „super resource“ for our economy?
4. **Why** do we modify the plants we use?
5. **Why** are our modifications on plants necessary?
6. **Why** are our improvements on plants criticised?

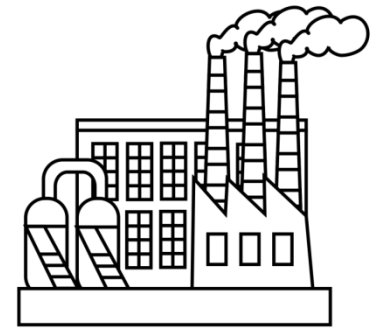


1. Why do we need plants?

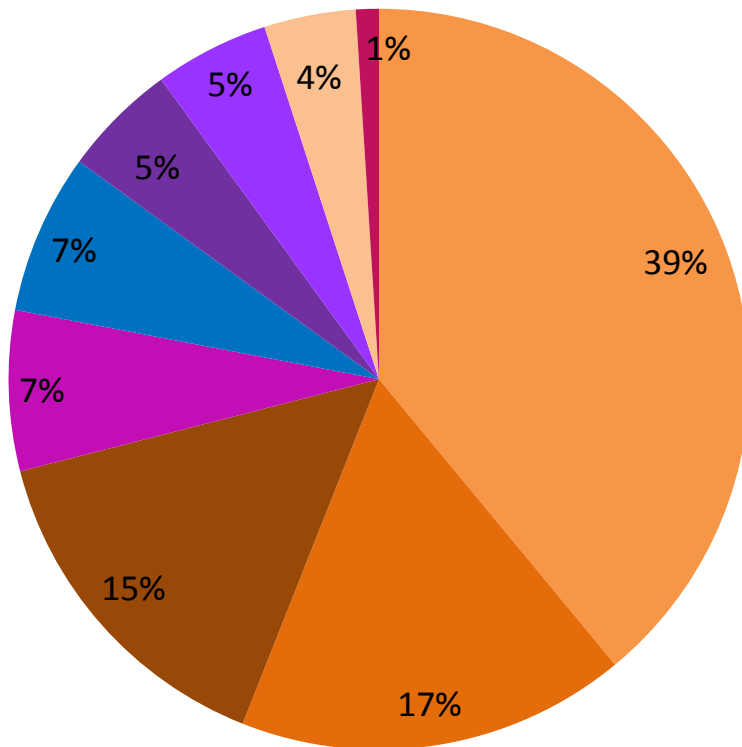


➔ Turnover in the EU-based economy (1 trillion Euro, 2013)

Excluding Food, beverages and tobacco products



www.ClipartsFree.de



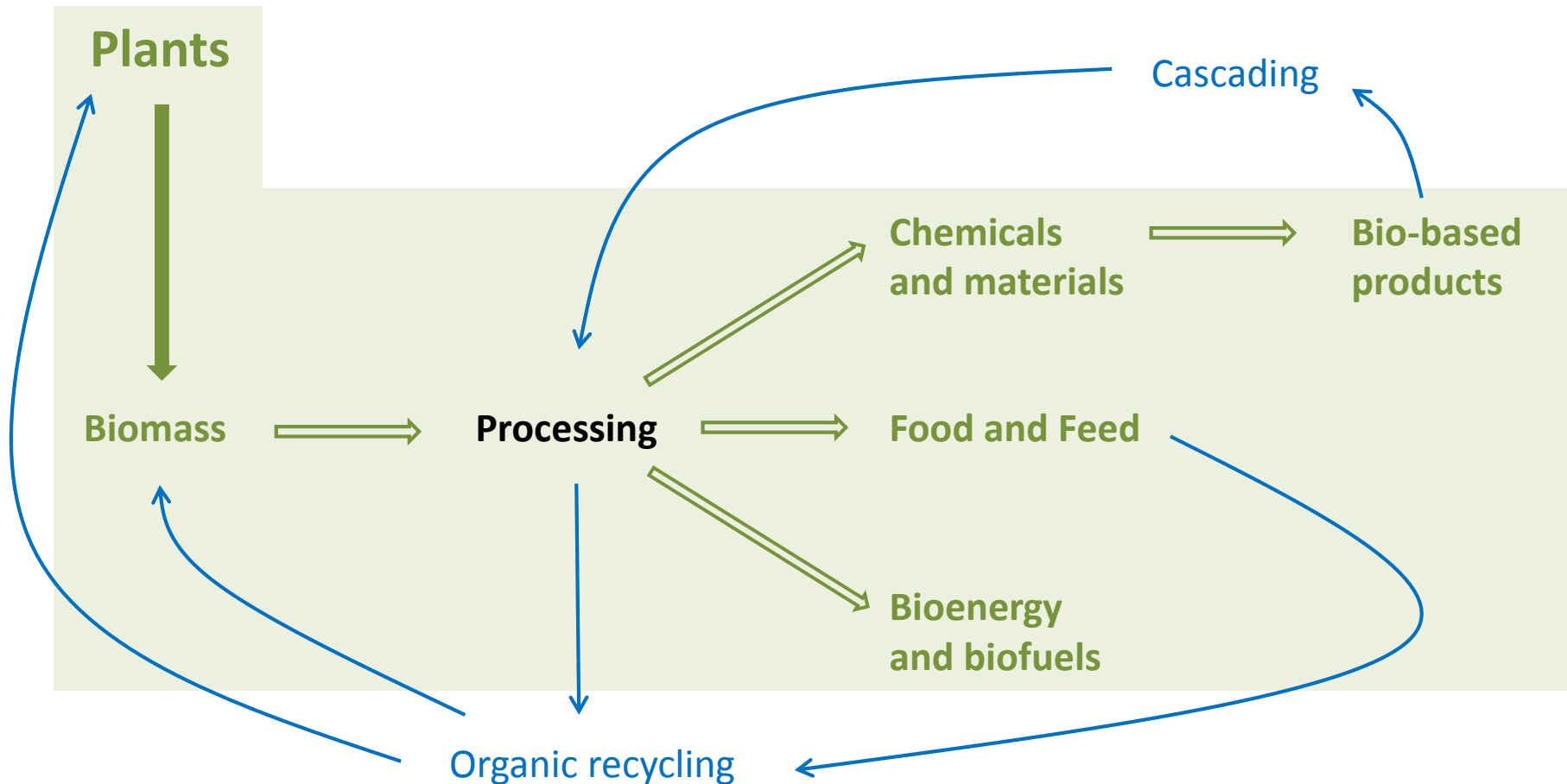
- Agriculture
- Paper industry
- Wood working industry
- Bioenergy
- Textiles
- Chemical industry
- Pharmaceutical industry
- Forestry
- Biofuels

Piotrowski et al., 2016. European Bioeconomy in Figures www.bio-based.eu/markets

2. Why can plants meet our needs in a sustainable way?

The aim of bioeconomy is to use as many parts / components of the plant as possible. The rest of the plant can be transformed in energy.

- Bioeconomy
- Circular economy



Adapted from Nova-Institute.eu / 2016
Bio-based.eu/graphics

3. Why are plants a „super resource“ for our economy?

Bioeconomy considers plants as suppliers of components.

⇒ **Proteins**
⇒ Enzymes

Lipids

⇒ Triglycerides
Colza and soya oil in Germany:
5-6 Mio t. / year

Lignin

Waste of paper industry
in Germany:
50 Mio t. of lignin / year



Fibers
Colorants
Vitamins
Drugs

Carbohydrates = Saccharides

⇒ Sugar, starch, cellulose

Sugar beets in Germany: 3,6 Mio t. / year

Wheat starch in Germany: 0,6 Mio t. / year

➔ Which plants' components are used in which industry?

Wide use
 Low use

	Sugar	Starch	Cellulose	Lipids	Proteins	Fibers	Lignin
Food, feed, aroma	Wide use	Wide use	Low use	Wide use	Wide use	Low use	Wide use
Biofuels, energy	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use	Low use
Pharmaceutics, cosmetics	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use
Paper	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use
Plastics	Low use	Low use	Wide use	Wide use	Low use	Wide use	Wide use
Adhesives	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use
Lubricants	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use
Paints, colours	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use
Textiles	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use	Wide use
Tensides, detergents	Wide use	Wide use	Wide use	Wide use	Low use	Wide use	Wide use

Biodiesel in Germany:
2 Mio t. / year – from colza and sunflower oils

Colophony, caoutchouc



Flavonoid Indigo
Carotenoid Betain



202 medicinals and spice plants in Germany

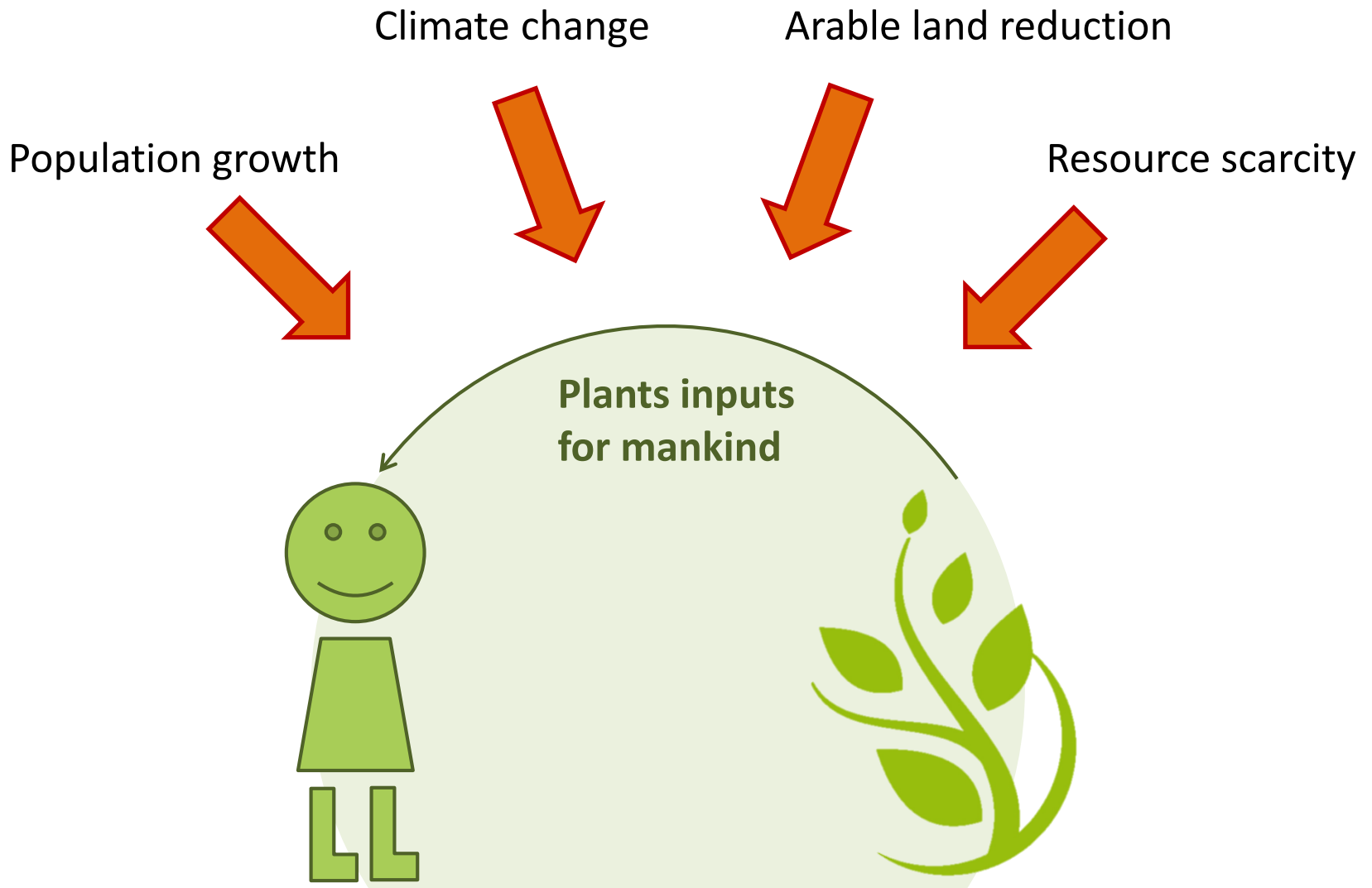
Plastics: 300 Mio t./year worldwide



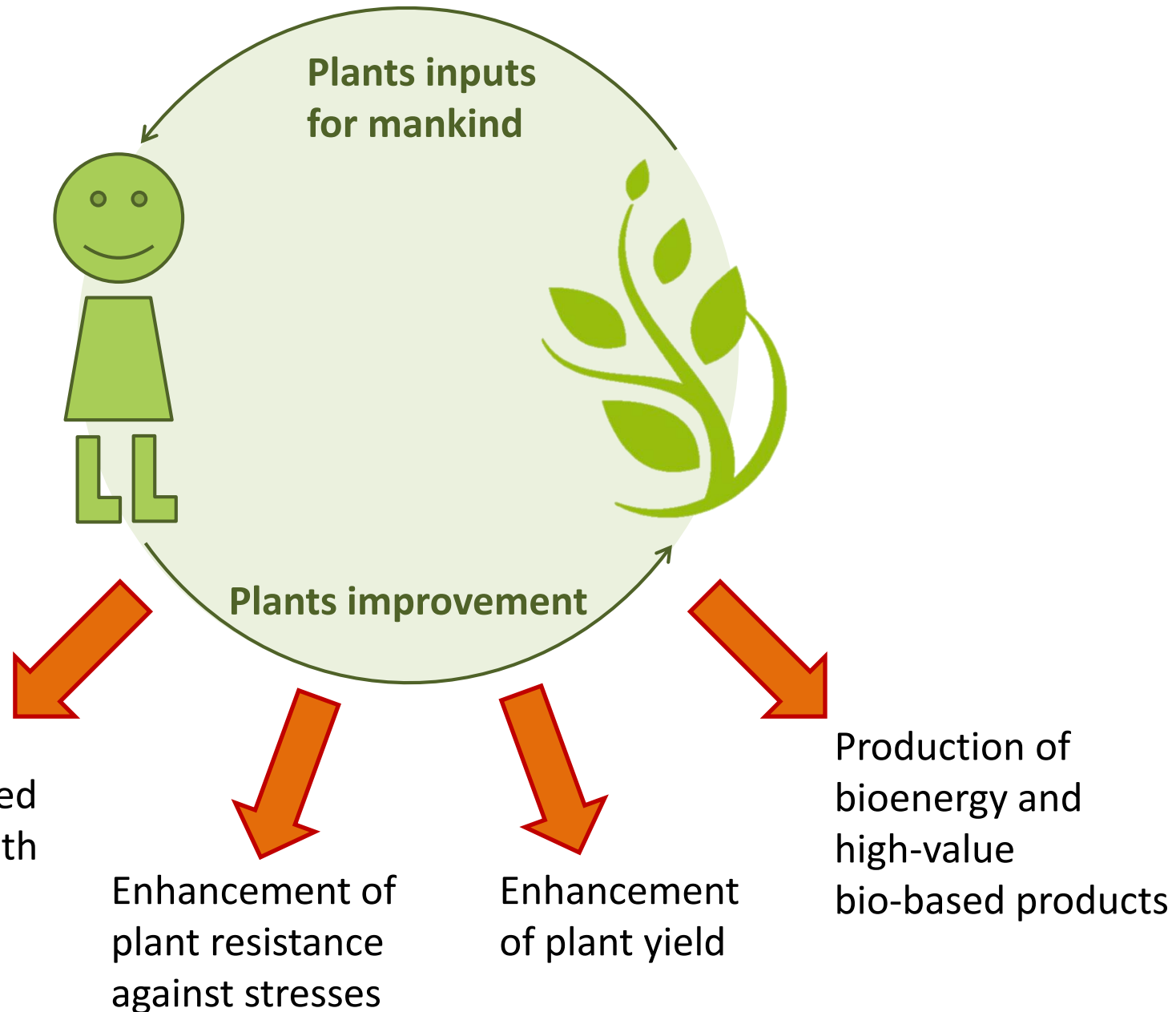
Textiles: Cotton, dyes, enzymes



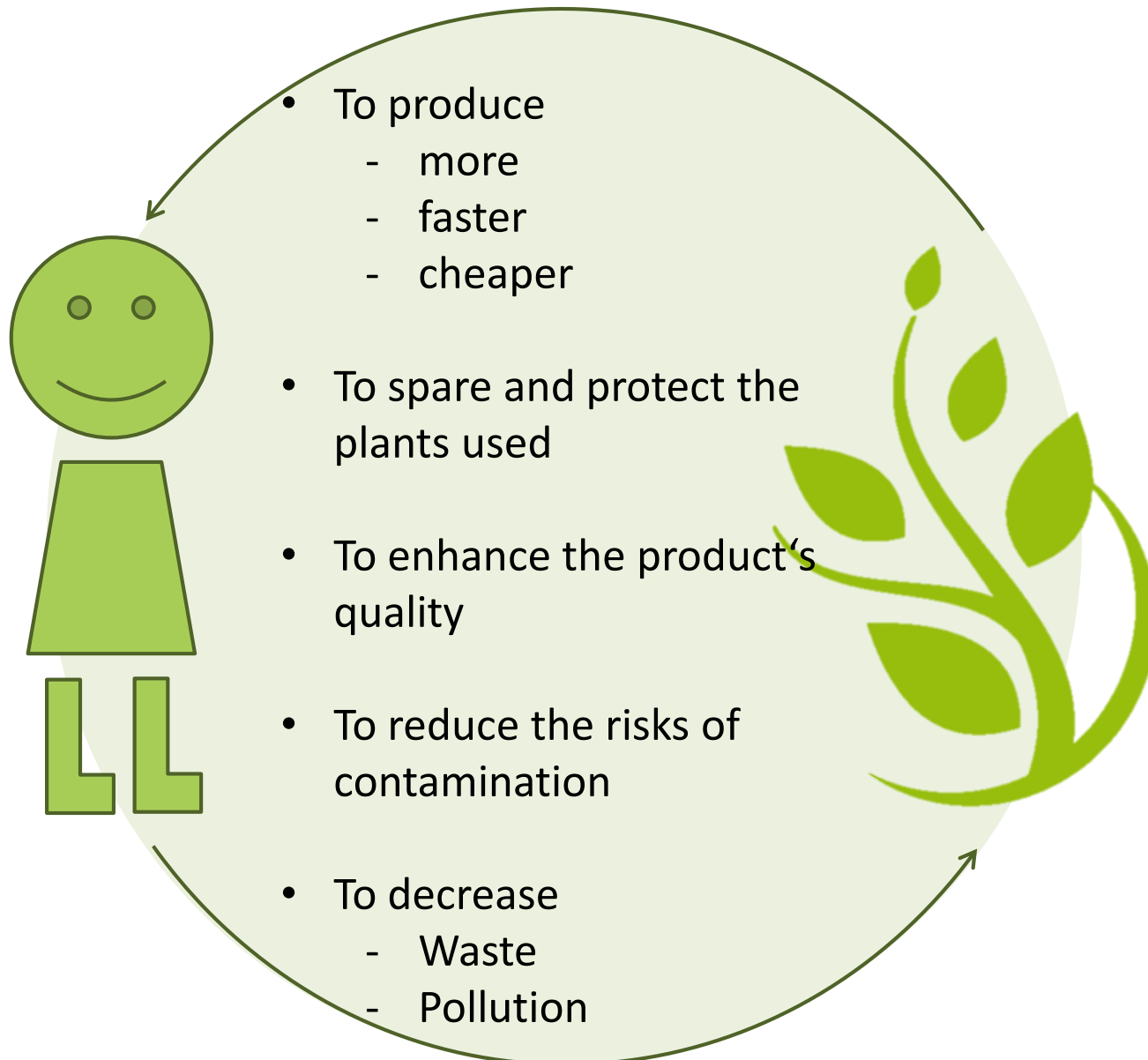
4. Why do we modify the plants we use?



➔ What do we expect by using improved plants?



5. Why are our modifications on plants necessary?

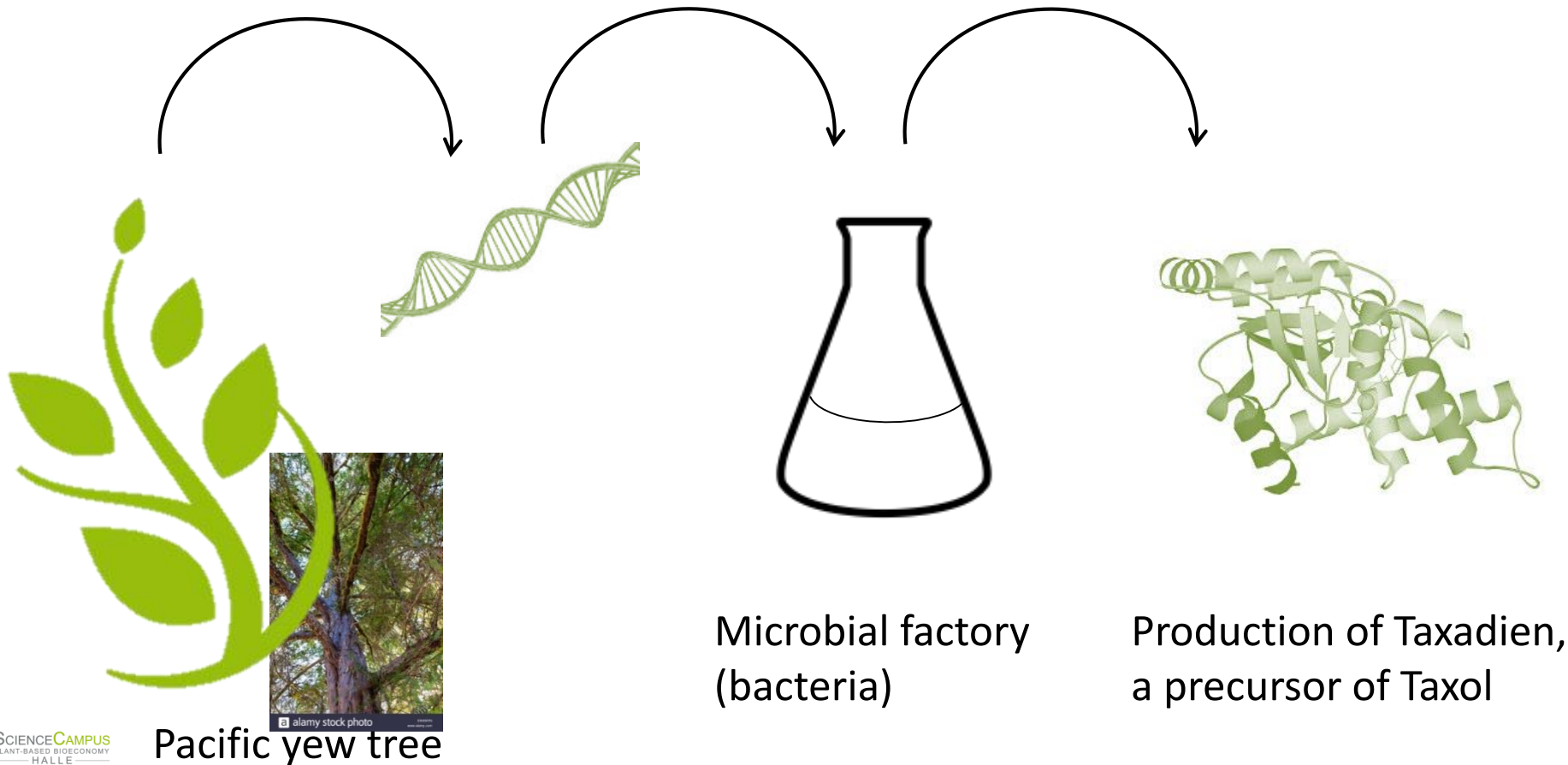


⇒ Producing more and faster and sparing biomass

Production of biopharmaceutics

Taxol is a drug used for the treatment of ovarian, breast, and lung cancer, as well as Kaposi's sarcoma.

Taxol is naturally produced in the bark of the Pacific yew tree.



➔ Producing cheeper

Industrial biotechnology

Expression of technical enzymes in transgenic plants.



Gene coding for the alpha-amylase from:

- (1) rice
- (2) *Bacillus licheniformis*

- (1) Tobacco
- (2) Pea

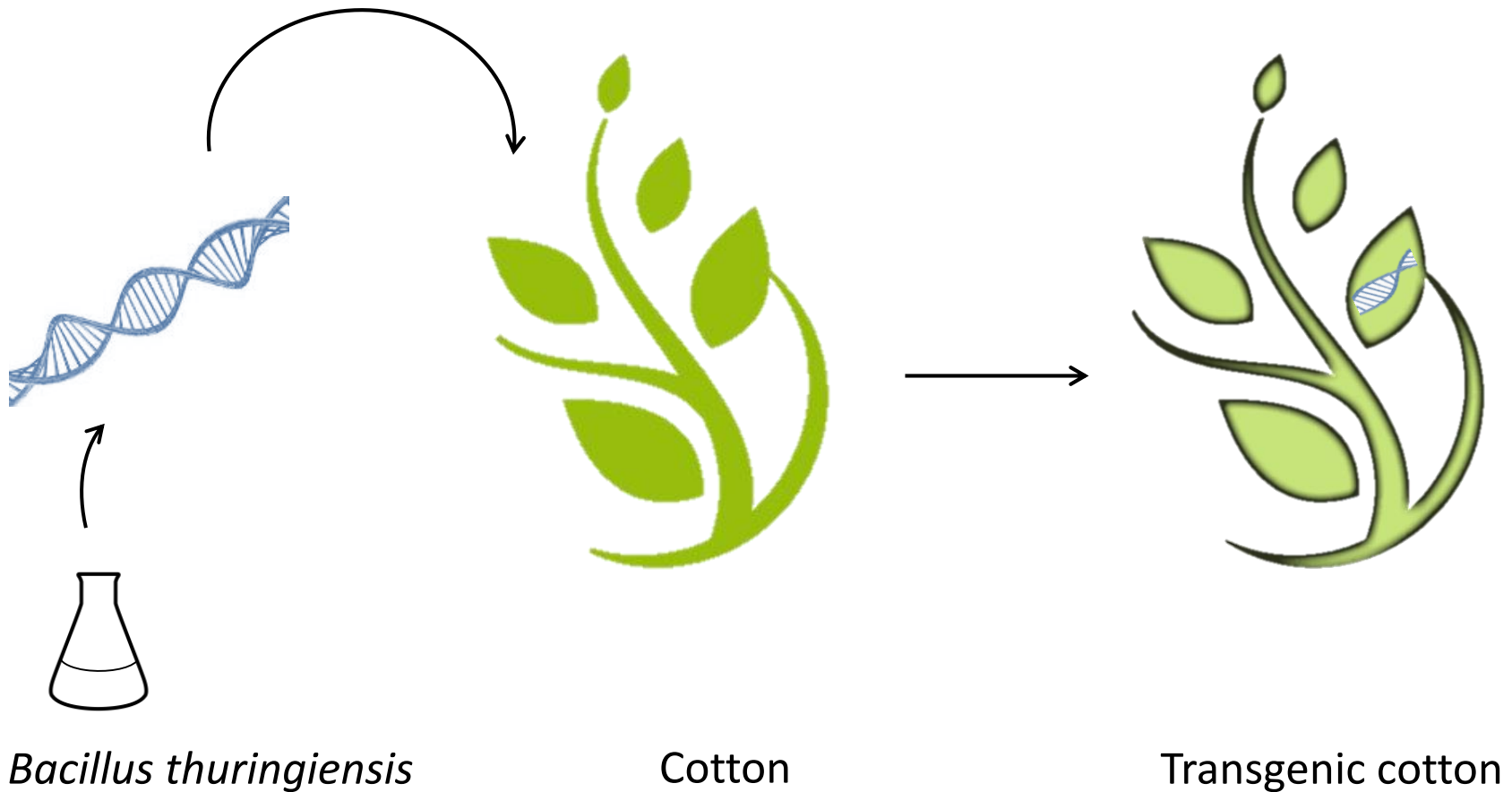
Transgenic plant

Production of alpha-amylase for alcohol preparation or detergents

⇒ Protecting the plants / biomass used

Production of recombinant proteins in plants

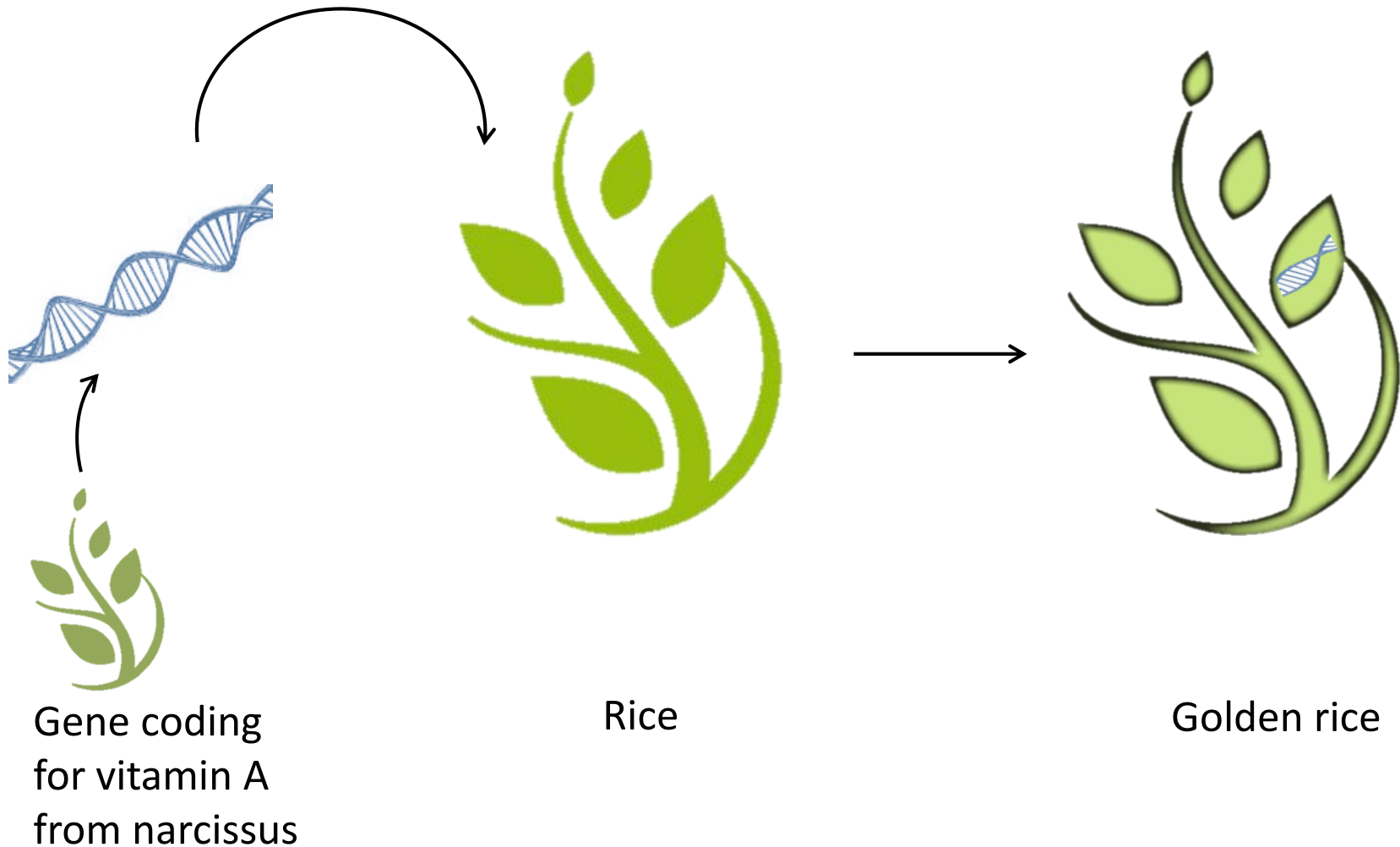
Plant synthesis of Bt-Toxin that protects the plant against insect pests without using pesticides.



⇒ Enhancing the plant products quality / properties

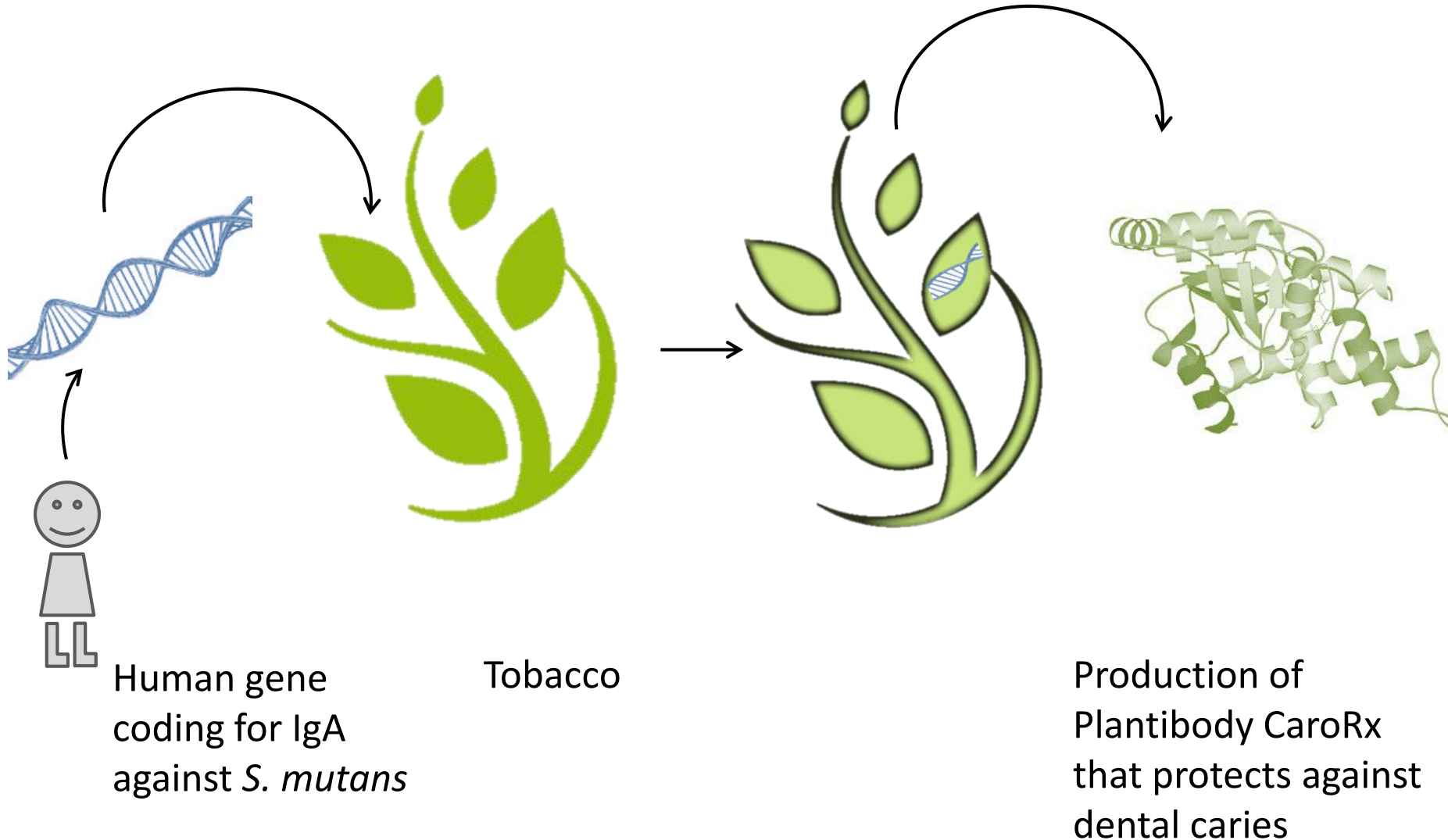
Production of recombinant proteins in plants

Golden rice enriched in vitamin A that protects people against blindness



➔ Reducing the risks of contamination and producing more and faster

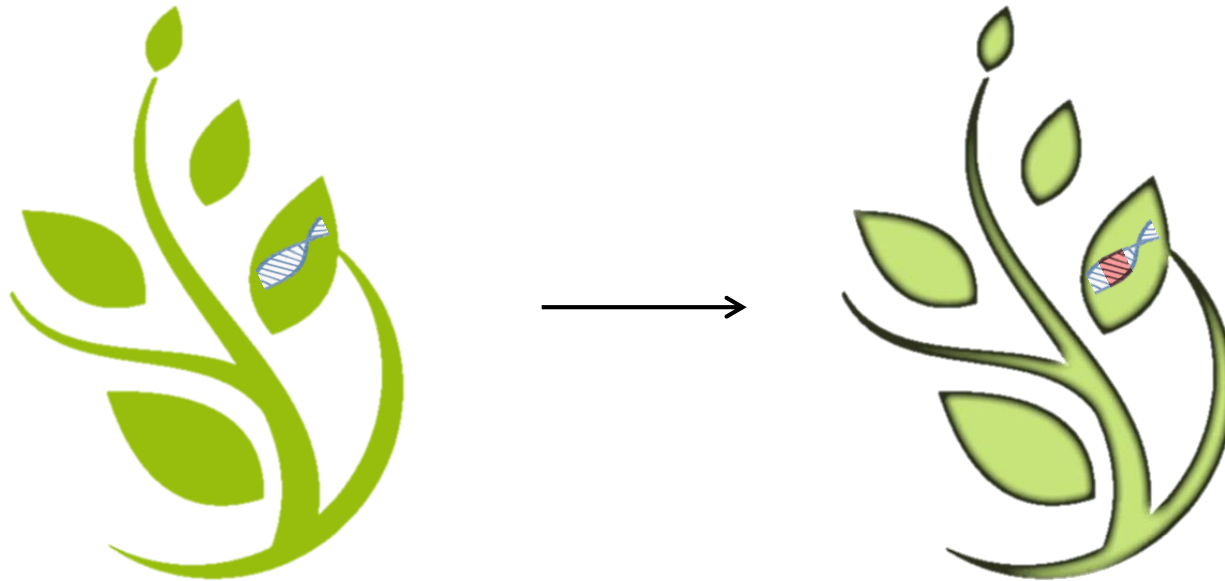
Production of plantibodies



➔ Decreasing waste and pollution

Genome editing

Modification of plants to optimize their use



(1) Decrease of lignin content with the aim to decrease pollution by producing paper and biofuels.

(2) Tomato that fructifies without fertilizer.

The gene of tomato that codes for the inhibition of fructification on barren soil has been mutated using the Crip r Cas technology.

6. Why are our improvements on plants criticised?

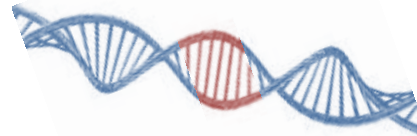


Biomass production

- Food, feed or fuel - conflict
- Effect of the increase of biomass production on the environment

Biomass transformation

- Use of genetic technologies
- High costs for SME to adapt their infrastructure to new technological processes



Economic and politic considerations of the bioeconomy

- Bioeconomy dependence on the price of fossil carbon
- Monopolisation: alliance of industry, investors, politics and research
- Reduction of research on alternative forms of economy
- High price of bioeconomic products

Dependence on the societal acceptance



Plants in our economy – Why things are done in that way?



Because we want “a sustainable biobased economy by 2030 that will be able to provide a wide range of healthy foodstuffs and high value products from renewable raw materials”.

BMBF, National Research Strategy Bioeconomy 2030