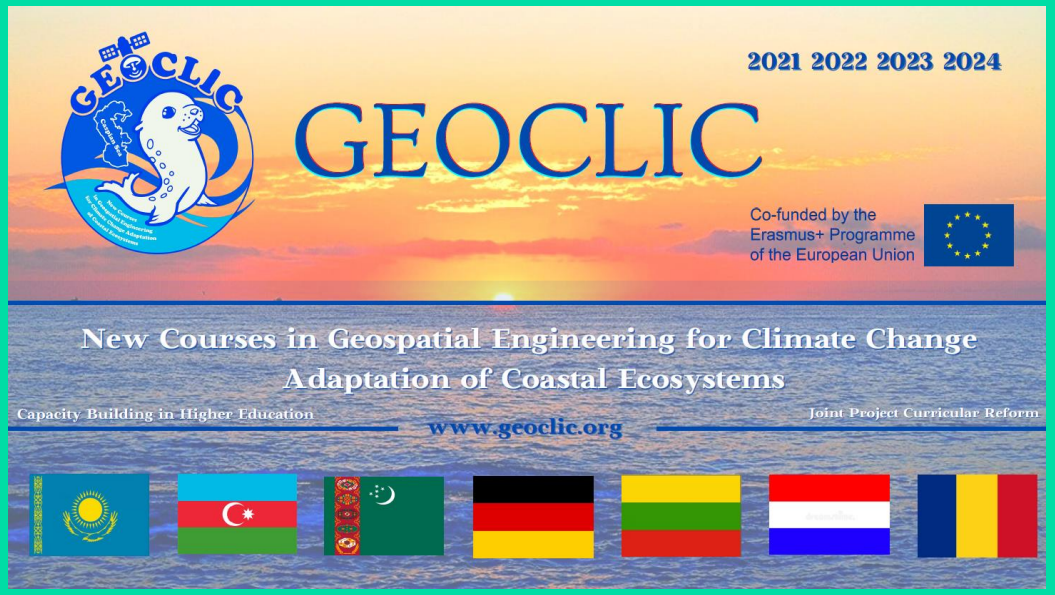



# Retraining for module „Ecological design“: practical examples and effective teaching methods

# Aim of the course

**Aim of the course:** To deepen and to improve skills for using main eco-design principles and strategies in product development phase.

| Discipline's title | | | | Number of ECTS | SWST Self-work of student with teacher, in hours | SWST Self-work of student without teacher, in hours |
|---|---|---|---|---|---|---|
| | Lect. | Pract. | Lab. | | | |
| **Ecological design** | **30** | **10** | **-** | **4 (120 hours)** | **6** | **74** |

# As a result of studying the discipline

- Get knowledge on main eco-design strategies and motivators, “life cycle thinking” concept;
- Gain skills to use different methods of environmental impact evaluation, which allows to evaluate product environmental impact and product performance;
- apply different eco-design tools in different industry sectors;
- decrease or eliminate negative environmental impact in the whole life cycle of a product;

# Assessments methods of students achievements

Student work is assessed according to a factor-based proportionate knowledge assessment system using a ten-grade assessment scale.
**Assessment uses a cumulative grade system**: student's knowledge and abilities are assessed for separate parts of the studies module during the entire semester.
The final assessment value is determined by multiplying separate grades by the weighting factor and summing them up.

Final assessment grade *(E)* formula:

$$E = (W_1 \cdot x) + (W_2 \cdot y) + W_3(C_1 \cdot z_1 + C_2 \cdot z_2 + C_3 \cdot z_3)$$

$W_1$=0,2;
$W_2$=0,4;
$W_3$=0,4;
x – Scientific seminar evaluation grade (up to 10);
y – control work evaluation grade (up to 10);
$C_1$,$C_2$,$C_3$ – weighting factors of examination's questions;
$z_1$, $z_2$, $z_3$ – assessment of exam questions (up to 10)**.**

# Literature


- Rodrigues, Vinicius P.; Pigosso, Daniela C. A.; McAloone, Tim C. Process-related key performance indicators for measuring sustainability performance of ecodesign implementation into product development.
- Dalhammar, Carl. Industry attitudes towards ecodesign standards for improved resource efficiency.
- di Sorrentino, Eugenia Polizzi; Woelbert, Eva; Sala, Serenella. Consumers and their behavior: state of the art in
- Pigosso, D. C. A.; McAloone, T. C.; Rozenfeld, H. Characterization of the State-of-the-art and Identification of Main Trends for Ecodesign Tools and Methods: Classifying Three Decades of Research and Implementation.
- Lewis, H., Gertsakis, J. "Design+environment: a global guide to designing green goods". Greanleaf publishing. Shefield, UK. ISBN 1874719438


Calendar (schedule) the implementation of the course content:

| Week | Topic title (lectures, practical classes, Independent work of students, IWS) | Number of hours | Maximum score |
|---|---|---|---|
| *1* | *2* | *3* | *4* |
| 1. | Lecture. Origins and development of Eco-design | 2 | 4 |
| | Practical class. The applicability of the eco-design method | 2 | 4 |
| 2. | Product environmental policy. EU policy on product development | 2 | 4 |
| 3. | Industrial technologies of ecological product for different objects | 2 | 4 |
| 4. | Eco-design strategy | 2 | 4 |
| | Practical class. Evaluation of selected ecological product | 2 | 4 |
| 5. | Eco-design tools and techniques | 2 | 4 |
| 6. | Product life-cycle concept | 2 | 4 |
| 7. | Eco-design as a tool in the manufacturing and services sectors | 2 | 4 |
| | Practical class. Virtual modelling of ecological product | 2 | 4 |
| 8. | Life Cycle Assessment | 2 | 4 |

| | | | |
|---|---|---|---|
| 9. | Product Environmental Impact Assessment | 2 | 4 |
| 10. | Product eco-design methodology | 2 | 4 |
| | Practical class. Ecological product creating | 2 | 8 |
| 11. | Evaluation and improvement of eco-design process and integrated evaluation of eco-design system | 2 | 4 |
| 12. | Advanced technologies of the ecological product creating | 2 | 4 |
| 13. | Eco-design management. Ecological product marketing in Caspian sea region | 2 | 4 |
| | Practical class. Scientific seminar – presentation of ecological product | 2 | 20 |
| 14. | Integrated evaluation of eco-design system | 2 | 4 |
| 15. | Product-service systems | 2 | 4 |
| | | | **SUM: 100** |

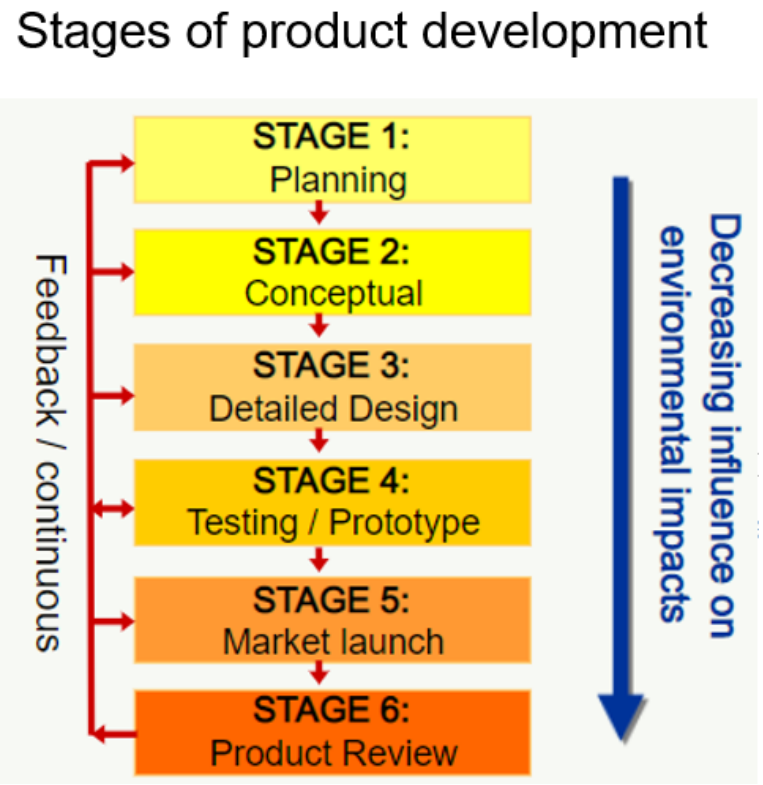
# Origins and development of Eco-design

Eco-design is used as a tool in the product and service sectors with the aim to increase sustainability and reduce negative environmental impact on the product design stage.

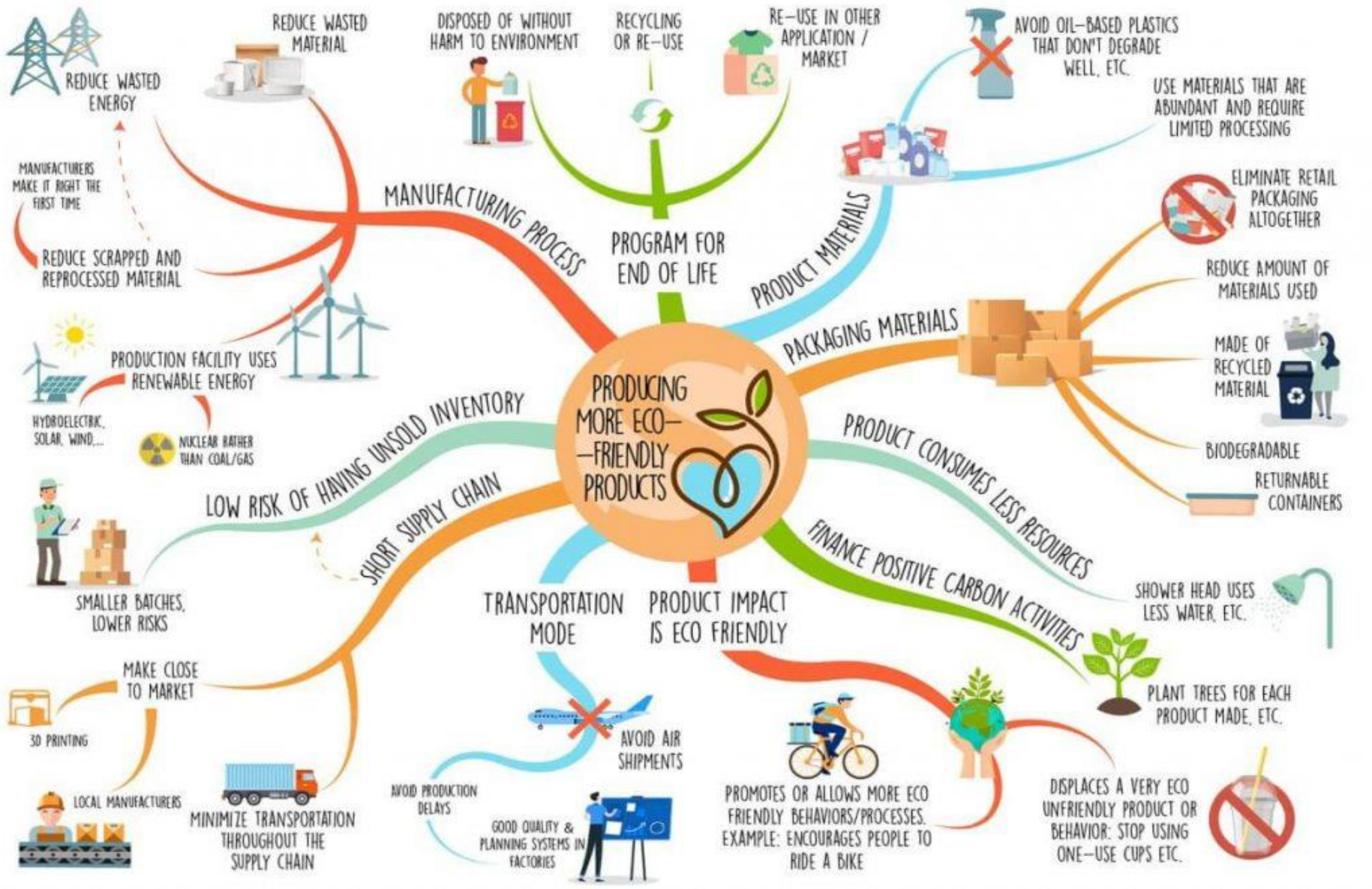
# Ecodesign principles

There are 10 core **environmental aspects** at the heart of ecodesign:

- using materials with less environmental impact
- using fewer materials overall in the manufacture of products
- using fewer resources during the manufacturing process
- producing less pollution and waste
- reducing the environmental impacts of distributing products
- ensuring that products use fewer resources when they are used by end customers
- ensuring that products cause less waste and pollution when in use
- optimizing the function of products and ensuring the most suitable service life
- making reuse and recycling easier
- reducing the environmental impact of disposal



# The applicability of the eco-design




Form of a mind map: https://www.youtube.com/watch?v=QxLofBREc9A&t=637s

# Principles of Eco-Design

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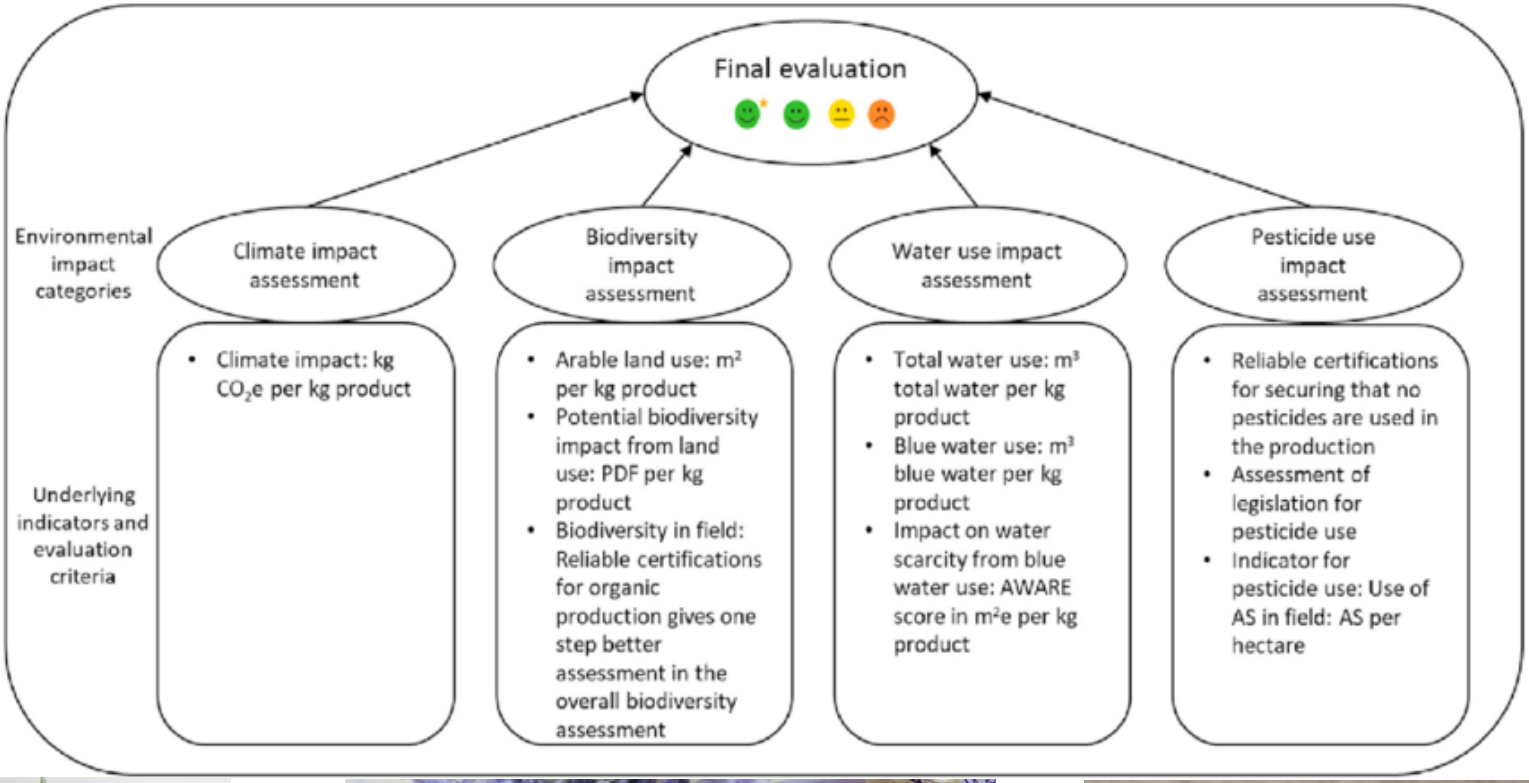
# Evaluation of selected ecological product



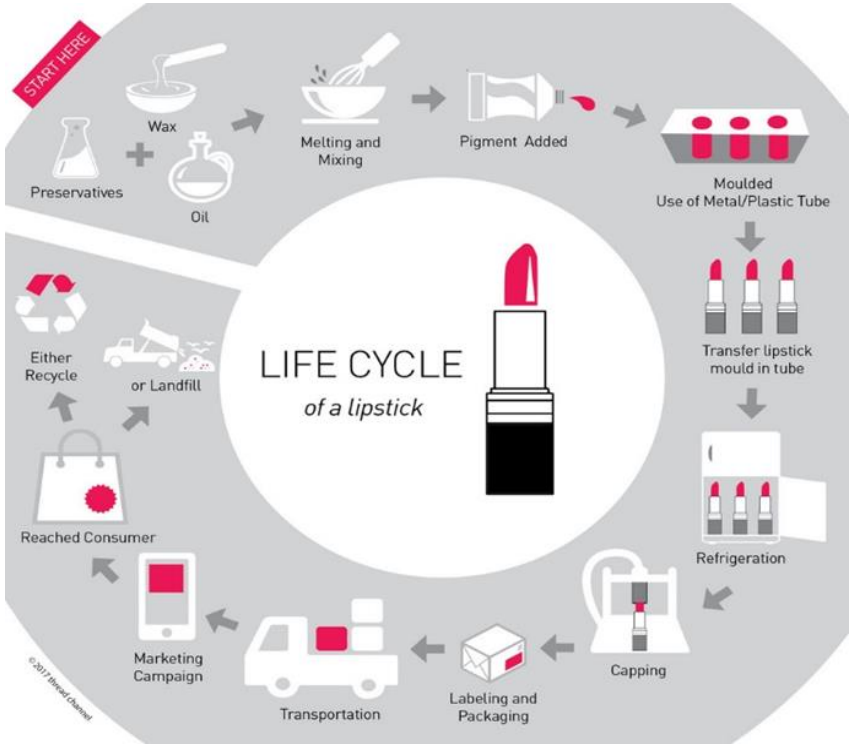

# Teamwork / case studies

- Formation of the teams for eco-design exercises
- Team size 2-5 students
- Each team chooses a product to work with (it can be revised or completely chosen during the course)
- Team composition may change during the course increasing, decreasing, joining, splitting etc.
- Each student is responsible for the performance of the entire team (each team gets marks that apply to each member of the team)
- Conceptual introduction, written essay, and short oral presentation in the class at the end of semester

# Team work / practice

Example case

- Typical lipstick vs. Eco-friendly lipstick




| **Typical lipstick** |
| --- |
| 4-5 months;<br>Available end of life treatment;<br>Cardboard recycling;<br>Plastic recycling;<br>lipstick ingridients harmful for evironment. |
| **Eco-friendly lipstick** |
| Lifetime - 1.5 month;<br>Paper recyclability and can work for a long time;<br>Ingridients are not harmful |

# Survey for Users

Form of the Survey

**ECO-FRIENDLY LIPSTICK**

**Aim: To evaluate the attitude of women towards eco-friendly lipstick.**

***1. Do you use lipstick?***
o Yes
o No

***2. Is the chemical composition of lipstick important to you?***
o Yes
o No

***3. Do You sort the waste?***
o Yes
o No

***4. Do you know what is the eco-lipstick?***
o Yes
o No

***5. Where did you find out about eco-lipstics?***
o Magazines, TV
o Friends / relatives
o Internet
o Advertisement stand
o Shop
o I have no idea what that is

***6. What kind of eco-lipstick brands do You know?***

***7. Will you pay more for eco-lipstick?***

o Yes
o No

***8. If the price of eco-lipstick and usual lipstick does not differ, which one would you choose and why?***

o Typical lipstick
o Ecological lipstick

# Raw materials

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| Raw materials of TYPICAL lipstick including size (Design) of lipstick | | | |
|---|---|---|---|
| Material | Amount, kg/item | Indicator, MP/kg | Result, MP/item |
| **Tube** | | | |
| Metal - nickel | 0,0030 | 5200 | 15,6000 |
| Plastic - PVC (rigid) | 0,0185 | 270 | 4,9950 |
| **Lipstick** | | | |
| Wax | 0,0016 | 99 | 0,1564 |
| Alcohol | 0,0008 | 99 | 0,0762 |
| Oils | 0,0014 | 99 | 0,1337 |
| Pigments | 0,0008 | 99 | 0,0792 |
| **Packaging** | | | |
| Package for each item | 0,0030 | 69 | 0,2070 |
| **TOTAL** | | | 21,2475 |

| Raw materials of REDESIGNED lipstick including size (Design) of lipstick | | | |
|---|---|---|---|
| **Material** | **Amount, kg/item** | **Indicator, MP/kg** | **Result, MP/Item** |
| **Tube** | | | |
| Carton | 0,015 | 69 | 1,0350 |
| **Lipstick** | | | |
| Vitamins | 0,00019 | 99 | 0,0188 |
| Natural oils | 0,00205 | 99 | 0,2030 |
| Natural pigments | 0,0009 | 99 | 0,0891 |
| **Packaging** | | | |
| 1 Package for 60 items | 0,0009 | 69 | 0,0621 |
| TOTAL | | | 1,4080 |

# Production

| Energy of TYPICAL lipstick | | | |
|---|---|---|---|
| Process | Amount, kWh/item | Indicator, MP/kWh | Result |
| Electricity (Europe) | 0,009 | 26 | 0,234 |

| Energy of REDESIGNED lipstick | | | |
|---|---|---|---|
| Process | Amount, kWh/item | Indicator, MP/kWh | Result |
| Solar energy (Electricity roof p-Si) | 0,003 | 10 | 0,030 |

# Disposal

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| Disposal of TYPICAL lipstick | | | | |
|---|---|---|---|---|
| Process | Material | Amount, kg/item | Indicator, MP/kg | Result, MP/item |
| Landfill | Plastic | 0,0185 | 2,8 | 0,0518 |
| | Metal | 0,0030 | 1,4 | 0,0042 |
| Total | | | | 0,0560 |

| Disposal of REDESIGNED lipstick | | | |
|---|---|---|---|
| Process | Amount, kg/item | Indicator, MP/kg | Result, MP/item |
| Recycling (99%) | 0,0135 | -8,3 | -0,1121 |
| *Landfill (1% remaining) | 0,0015 | 4,2 | 0,0063 |
| Total | | | -0,1058 |

# Typical vs redisigned lipstick

| Total | MP/item |
|---|---|
| TYPICAL lipstick | 22,2175 |
| REDESIGNED lipstick | 1,6722 |

Natural lisptick itself has less impact on environment;

Comparison of Eco indicators – the main reason why redesigned lipstick had less environmental load:

- 1. raw materials - metal and plastic were replaced with carton.
- 2. the typical electricity was replaced with solar energy.

The result: eco-indicator system evaluation for redisigned lipstick is possible to make lipstick more than 10 times ecofriendlier.

# Soap Project

- goal – to spread knowledge about sustainability
- Workshop about “How to make ecological soap by yourself?”
- Target group: students
- Educational purpose

# Ingredients

Caustic soda (Lye)

Oils

Water and energy

# Caustic soda(lye)

What is it?
- It's a white solid ionic compound

Why do we need that?
- We must get the saponification process

Which seller did we choose? Why?
- Olin corporation
- Policy

How much is it?
- the cost is 2.89 € for 1 kg of caustic soda.

Where will we buy it?
- Olin product is sold in local hardware stores.

# Linseed oil

- Extracted from flax seed
- World main producer:  Lithuania
- Supplier: Senoji aliejinė (located in vilnius, LT)
- Price: 7-10 EUR per litre
- Extremely good for both face and hands
- Good for skin diseases: rosacea, acne, dermatitis,eczema or psoriasis.

# Soap making utensils

- Cake or muffin mold (*€ 20)
- Cooking pot (*€ 30)
- Hand blender (*€ 30)
- Kitchen scale (*€ 15)
- Bowl (*€ 25)
- Measuring cups (*€ 7)
- Kitchen spoon and spatula (*€ 7)
- Thermometer (*€ 10)
- Cleaning utensils (vinegar) (*€ 5)
- Gloves, reusable (*€ 1,50)
- Safety glasses (*€ 2)

*prices are per item and estimated (amazon.com)

# Soap making process I

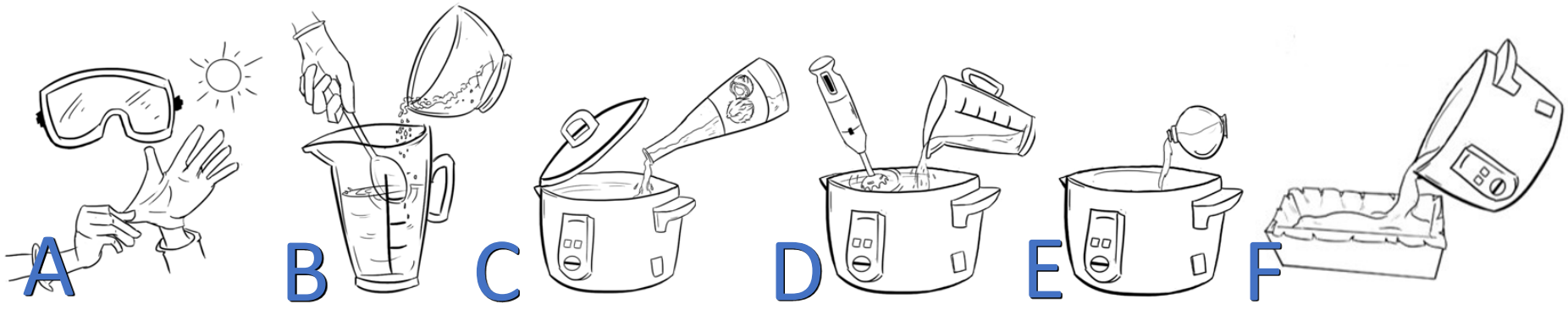
A: put on protection

B: mix lye in water and stir gently, and cool for about 10 minutes

don’t breathe in the vapor and the mixture will get hot

C: heat linseed oil to low temperature

temperature of linseed oil and lye mixture needs to be the same (45-50 °C)

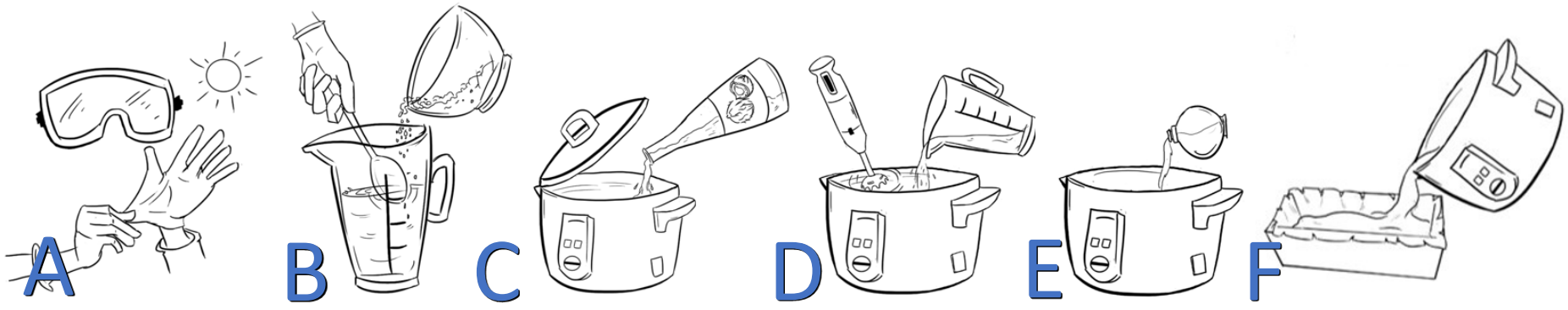


# Soap making process II

D: add lye mixture to the heated linseed oil and blend until well mixed, cook for 45 to 60 minutes, stir it from time to time

E: optional; adding essential oils, leaves and flower petals in the cool mixture

F: pour soap mixture into mold and let it cool (approx. 2 days)



| GOLDEN RULES OF SUSTAINABLE DESIGN | OUR SOAP PRODUCT |
|---|---|
| no toxic substances | no toxic substances, biodegradable |
| minimal resource/ energy consumption in production:<br><br>in use phase: | minimal packaging and weight compared to liquid soap (relatively small scale → must prevent resource waste)<br><br>no energy consumption, no waste |
| promote long life | longevity: 500 uses per bar of soap (depends on individual use) |
| protect product | minimal packaging (for instance newspaper) |

# Advantages of workshop's

- small scale projects are easy to control
- educational aspect (for all ages)
- simple process
- sustainable soap production
- local ingredients (as far as possible)
- reduced packaging

- resource efficiency on small scale not optimal
- hard to calculate exact expenses
- dependant on funding

- individual soap creation
- connects concept of sustainability to everyday object
- viable for financial support (social project)

- lots of individual planning
- dependent on cooperation (with schools for example)

# Life Cycle Assessment

**What is LCA?**

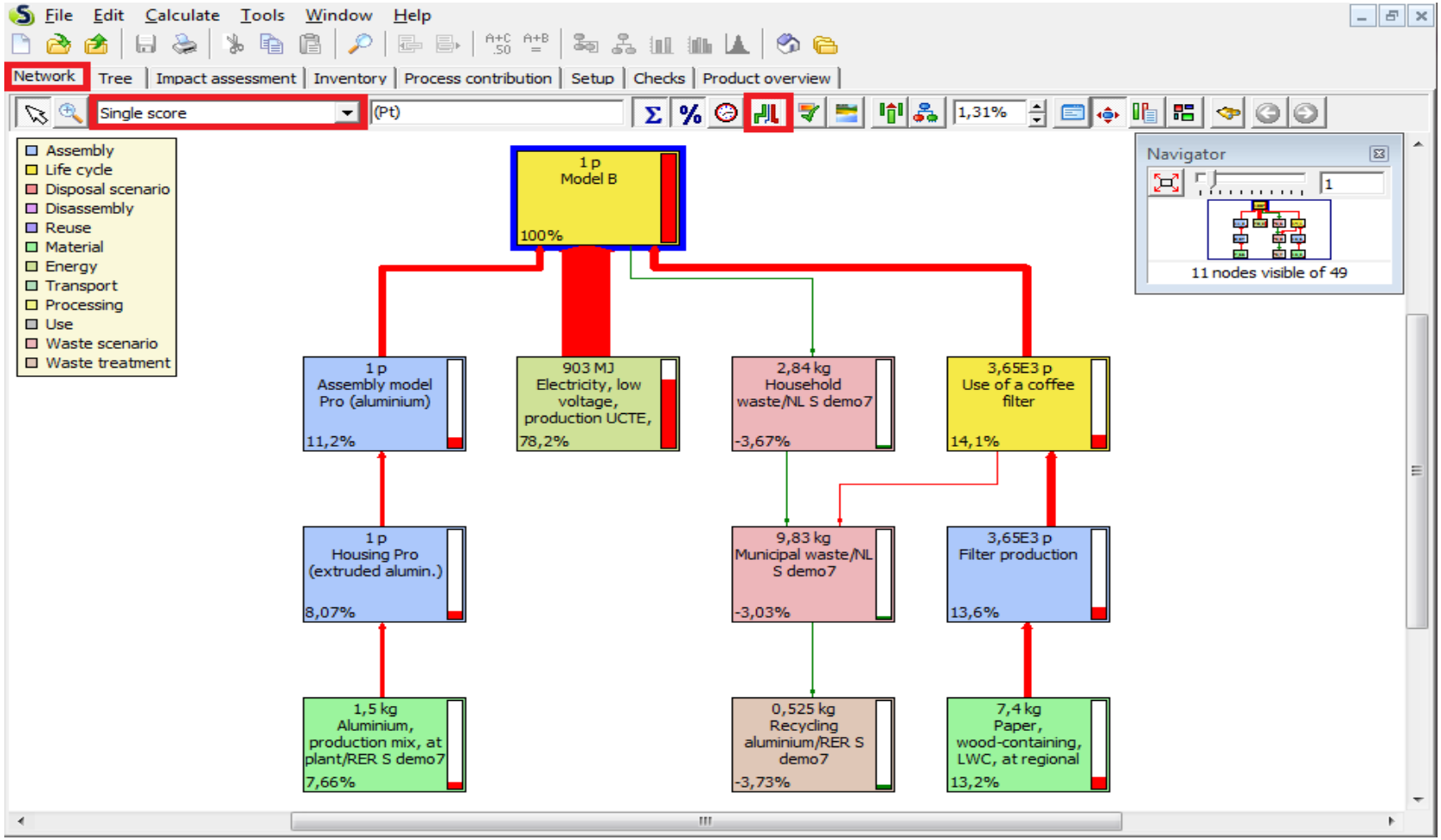
- LCA is a method that quantifies the environmental impacts of a product throughout its entire life cycle.

**How is LCA performed?**

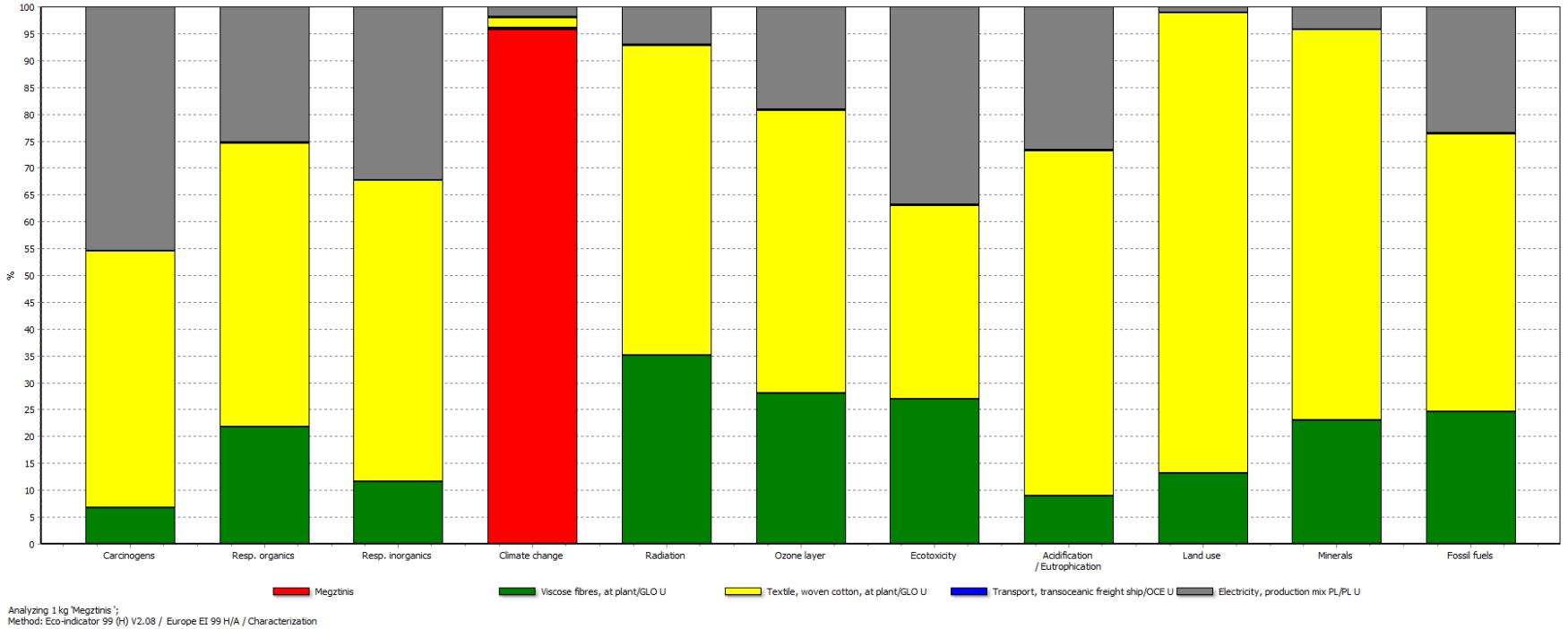
- What are the stages?
– How much energy and water are needed?
– What materials are needed? How much? Where do they come from?
– What is it produced at each stage? How much of it?
– How do they contribute to the different environmental impacts?

# LCA tool - SimaPRO

SimaPro helps you effectively apply the sustainability expertise, to help empower solid decision-making, change products' life cycles for the better, and improve positive impact.



# Impact for the different categories




- Carcinogens
- Effects of organic substances on respiration
- Effects of inorganic substances on respiration
- Global warming
- Ecotoxicity
- Acidification/Eutrophication
- Land use
- Mineral extraction
- Non-renewable resources
- Ozone layer

# Product Carbon footprint (PCF)

- Product Carbon footprint (PCF) has an portant role.
- PCF is one of the indicators that can be calculated with LCA, being an **understandable environmental indicator** used not only as quantitative data of the current environmental performance but also as benchmark for further improvements.
- PCF - as strategy for **environmental communication to consumers through eco-labelling.**

- The main strength of Carbon Footprint is that stakeholders (business and consumers) are aware of and understand its meaning due to the presence of carbon emissions and global warming in mass media and public science studies.

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# Thank You for Your attention!