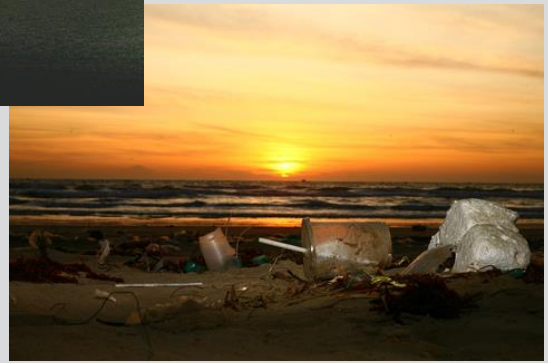
# Plastic – a curse or a blessing?

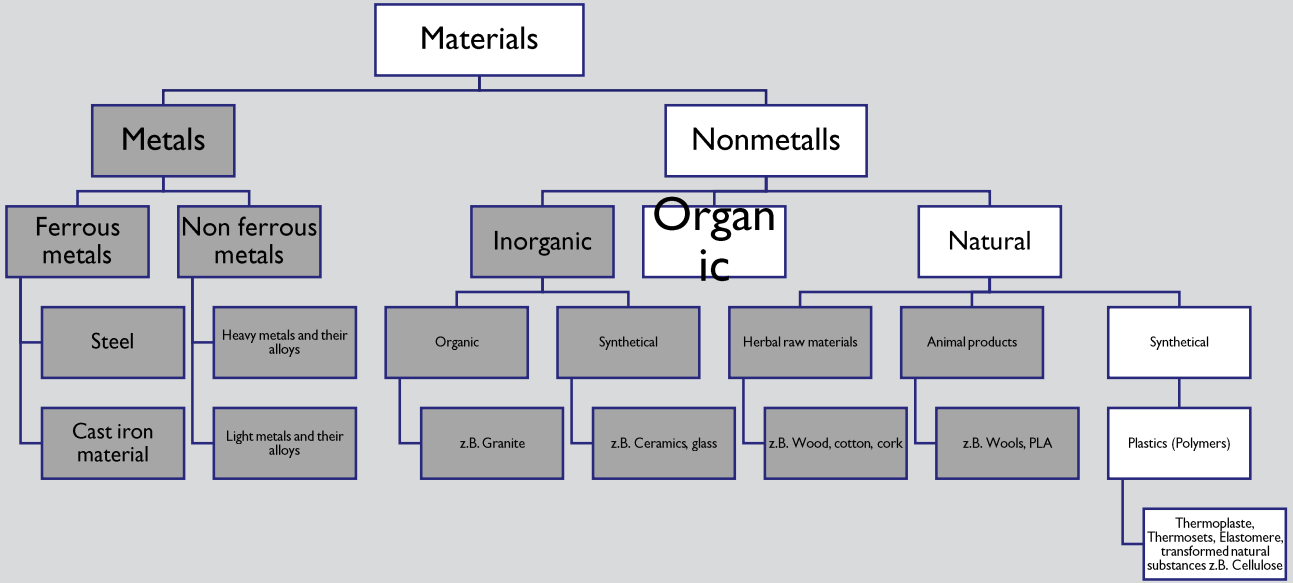


# Recycling stops greenhouse gase

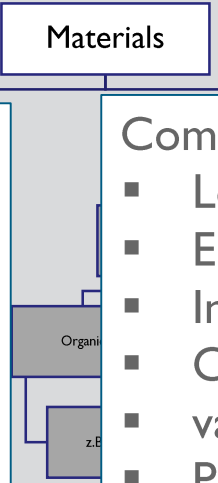
## Workshop schedule Part II

- Plastic– a ingenious material
  - **Density test**
- Circular economy – Theory and praxis
- Recycling
  - **Recycling example Thermoplastics: Making a synthetic fiber**
  - Outlook
  - **Making bioplastic by hand**

# Plastic – a ingenious material



# Plastic – a ingenious material




**Plastics (= Polymers)**, are **synthetically manufactured, macromolecular, organic materials.**
They can be categorized in different types of plastic, that differ in their properties.

Common typical properties:

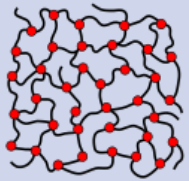
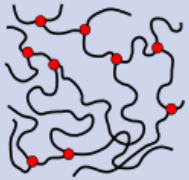
- Low density (0,9 – 1,4 g/cm$^3$)
- Electrically insulating
- Insulates against heat and cold
- Corrosion resistant
- variable mechanical properties
- Partly foamable and spinnable

# Experiments on the properties of plastic

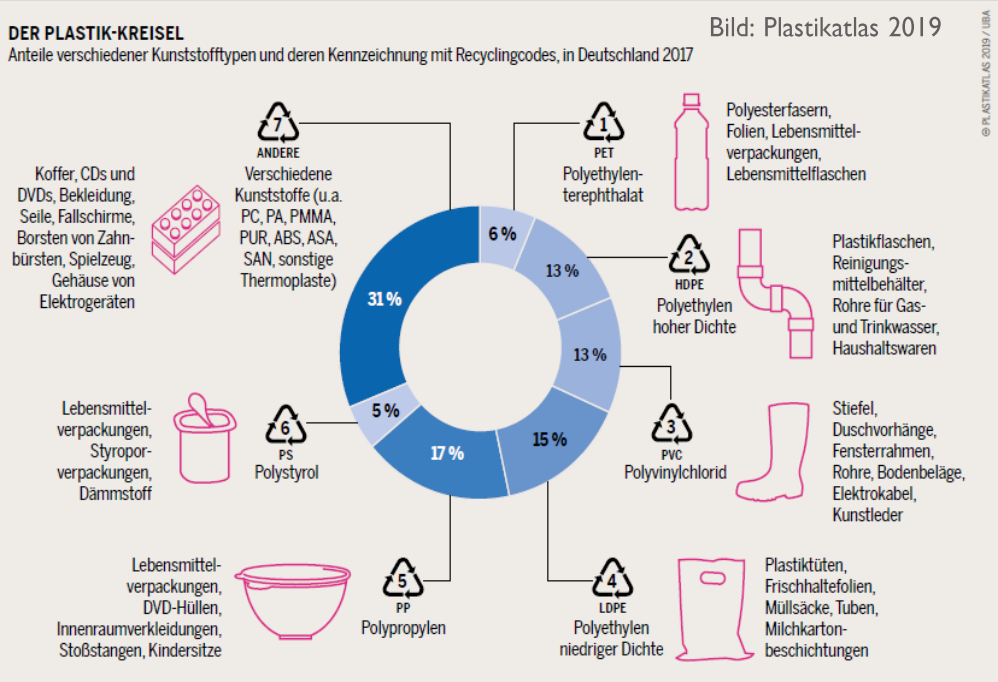
- Experiment to detect the different densities of plastic particles

| Material / Recyclingcode | Density [g/cm$^3$] = [g/ml] |
|---|---|
| **PP** /05<br>Polypropylene | 0,9 – 1,0 |
| LD**PE** / 04<br>Polyethylene | 0,915 – 0,935 |
| **PS** / 06<br>Polystyrene | 1,05 |
| **PET** / 01<br>Polyethylene terephtalate | 1,30 – 1,32 |
| **Water** | 1,0 |
| **Saturated salt solution** | 1,2 |

# Categories of plastic

| Thermoplastics | Thermosets | Elastomers |
|---|---|---|
| filamentous, non-cross-linked macromolecules, often with a semi-crystalline structure | Tightly meshed, cross-linked macromolecules | Wide-meshed, cross-linked macromolecules |
| if heated up formable and weldable  | even heated up non-formable and non-weldable  | even heated up non-formable and non-weldable  |

# Plastic applications




Please, sort the packaging based on their recycling code.

# Plastics and their use

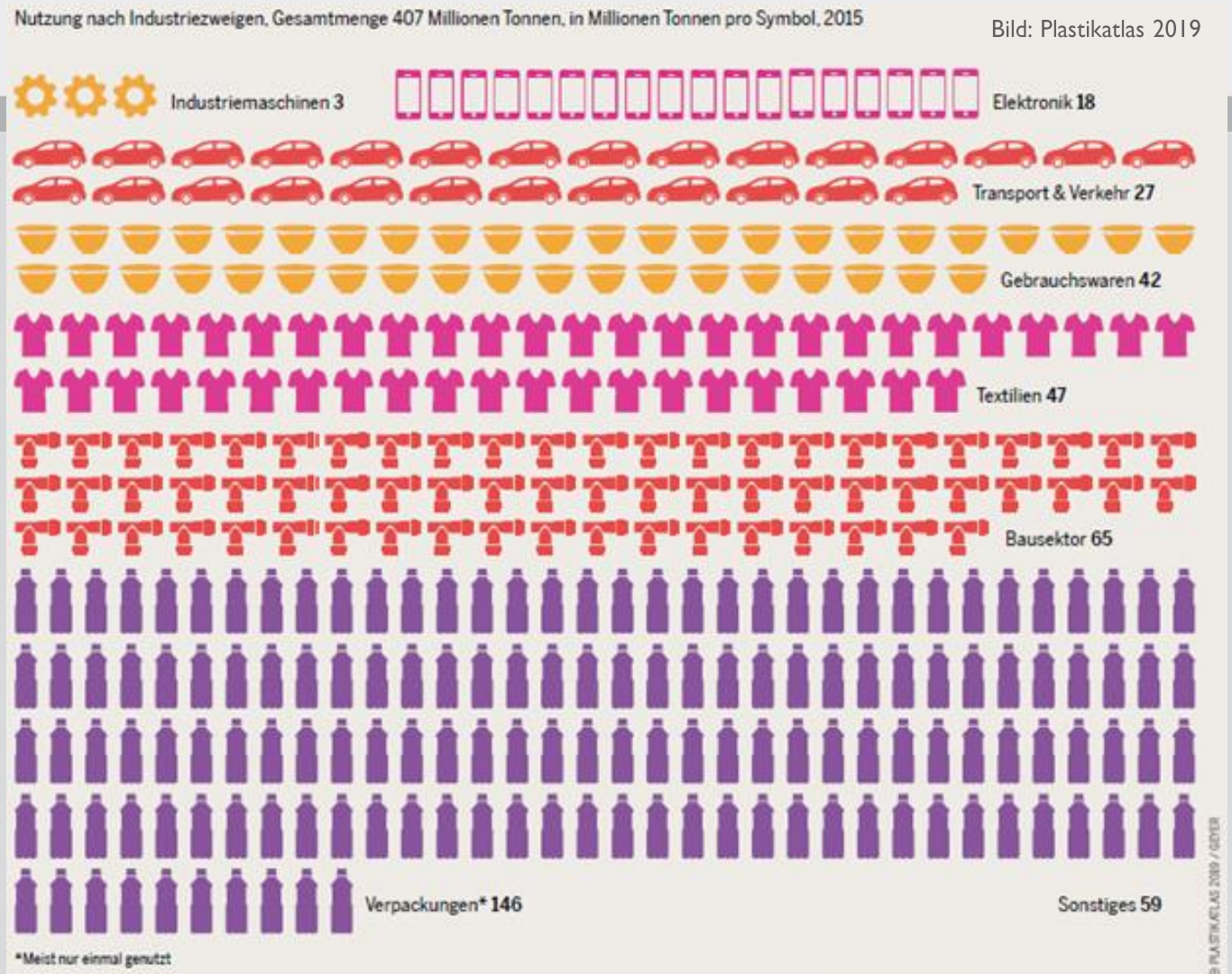
Where is plastic used?

How many kilogram of plastic waste are produced in the Production of a mobile phone?

How did the changes from the AGEC (1.1.2022) alter your perspective for plastic in your life?

How conscious are you of plastic in your life? Did laws, such as the recycling of textiles and shoes (since 2021), caused changes in your awareness with plastic waste?

Bild: Plastikatlas 2019

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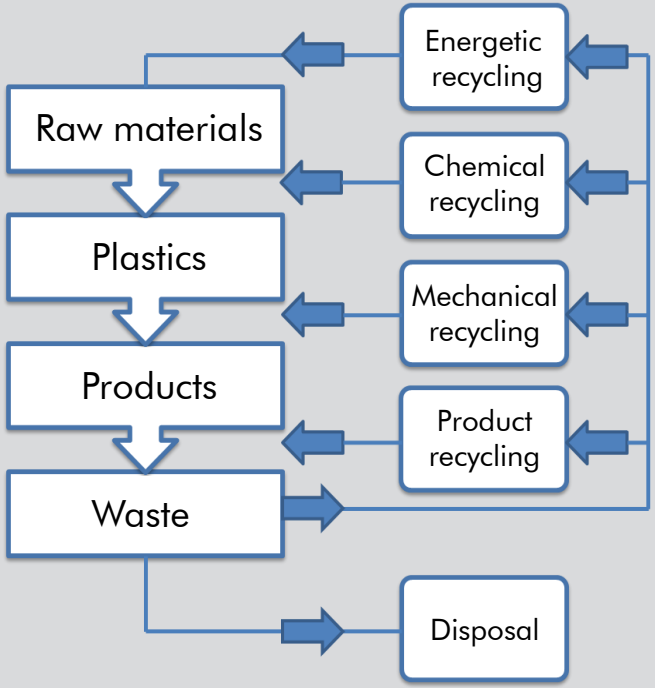
# Plastic recycling

**The most important regulations of the KrWG (=Kreislaufwirtschaftsgesetz/ Circular economy Act)** [EU policy 2008/98/EC - Waste Framework Directive]

The core element of the KrWG is **the five-level-waste hierarchy**. Accordingly, the following order of priority applies for the waste management measures:

- Avoidance
- Preparation for reuse
- Recycling
- other recycling, in particular energetic recycling and backfilling
- Disposal

# Plastic recycling ESD (Education for sustainable development): economic Dimension



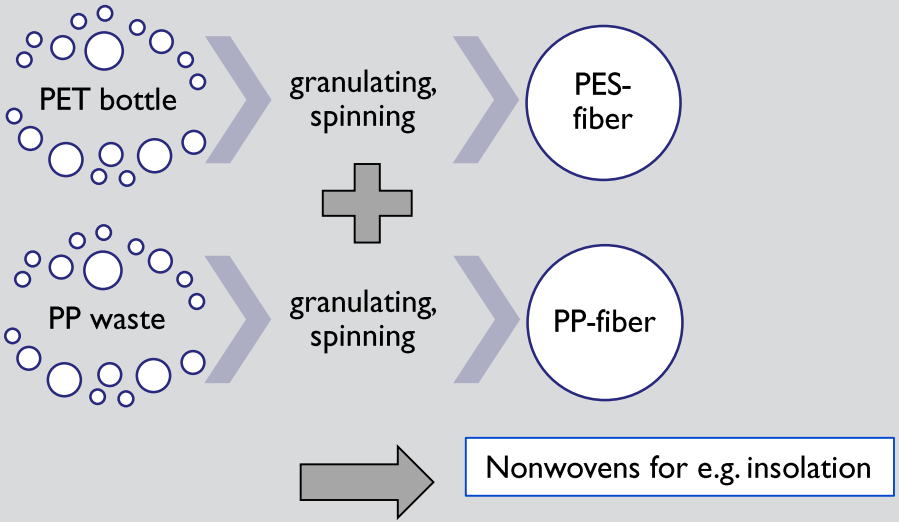

| Designation | Methode |
|---|---|
| **Chemical Recycling** (Macromolecules are decomposed) | Solvolysis (Dissolving)<br>Depolymerization<br>Pyrolysis (Cracking)<br>Gasification |
| **Mechanical recycling** (Macromolecules remain unchanged) | Sorting, sieving, density separation. Grinding, degranulation and e.g. extrusion |

# Plastic Recycling

Mechanical recycling of various thermoplastics for fiber production

Experiment: „Making“ fiber out of a drinking straw (with PP or PE plastic straw)

**Example: plastic recycling for the automotive industry**

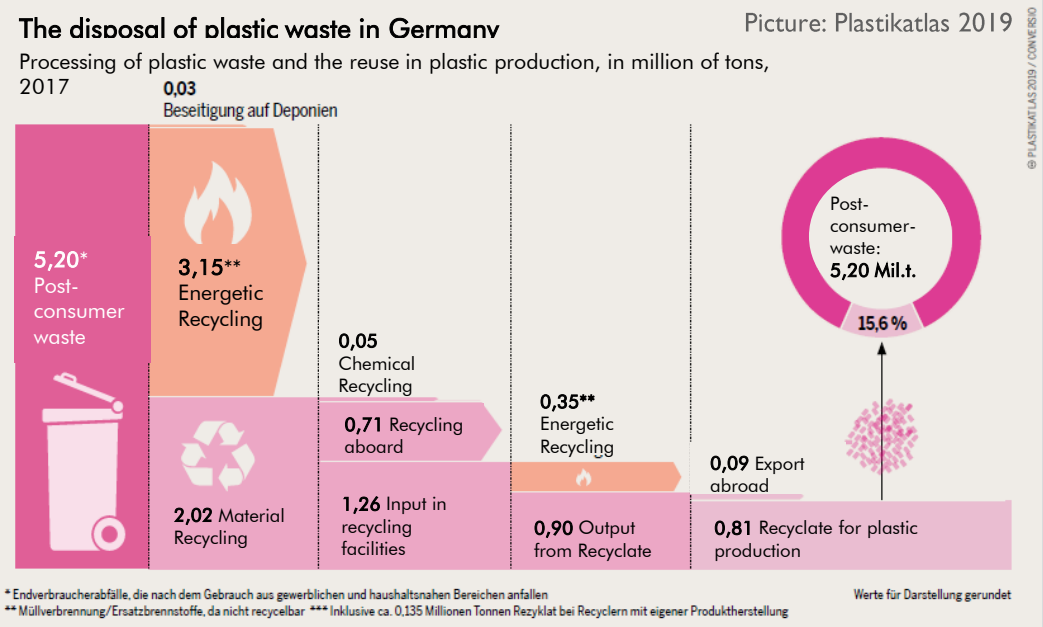


# PET –plastic of the future?

In practice:
Mechanical recycling of PET, to PET Recyclate for PET Bottles (bottle-to-bottle) or for film and textile production

- Polyethylene terephthalate (PET) are a thermoplastic polymer
- Great variety of uses (Foils beverage bottles, Textiles fibers)
- Reversing the synthesis allows the material to be fully recycled
- PET can be used for all packaging
- Development of biodegradable PES fibers seems technically possible [https://www.recyclingmagazin.de/2021/08/30/biologisch-abbaubare-polyesterfasern-aus-rezyklat/]
- Latest research over PET recycling:
  https://www.swr.de/wissen/enzym-zersetzt-pet-kunststoff-in-rekordzeit-100.html
  https://biooekonomie.de/nachrichten/neues-aus-der-biooekonomie/riesenappetit-auf-den-kunststoff-pet

# Plastic recycling ESD: economic dimension




## Current situation:

- Right now there is no circular economy, but rather linear disposal
- New produced plastic „Virgin Plastic“ is cheaper than the recycled material
- Mechanical recycling fails due to composite plastics and high costs
- Chemical recycling has so far not been successful enough on an industrial scale

# Environmental impact

Videoempfehlung: „Plastik in der Umwelt“ auf youtube


Bild: Plastikatlas 2019

# Outlook

| Politics and economy | Just do it yourself |
| --- | --- |
| Cradle to Cradle Designconcept<br>Prof. Dr. Michael Braungart | Public drinking fountains and Refill-stations<br>→ e.g. Chemnitzer Wasserquartier |
| Cirplus – A global marketplace for circular plastics | cero-waste: Processes and systems that do not generate waste |
| From 2025 in the EU: >50% of the packaging waste should be recycled | The first step is to stop using plastic products that are only used once |
| From 2022, the recycling rate for plastic packaging should increase to 63% | Experiment: Making a starch foil (Topic: bioplastics) |

# BNEebenbei – Plastic: Curse or blessing?

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[1] https://www.sueddeutsche.de/wirtschaft/plastik-recycling-corona-1.4973050; 10.11.2021
[2] Hochschule Magdeburg-Stendal im Auftrag der Kunststoffrecycling-Unternehmen mtm plastics GmbH, Multiport GmbH und MultiPet GmbH (https://www.chemie.de/news/148801/co2-vermeidung-durch-kunststoffrecycling.html; 10.11.2021)

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