ENVIRONMENTAL ISSUES IN MATERIALS SCIENCE AND ENGINEERING

Vineta Srebrenkoska[1], Emilija Fidancevska[2]

[1]*Faculty of Technology, Goce Delčev University, Štip, Republic of Macedonia,*

[2]*Faculty of Technology and Metallurgy, Sts.Cyril & Methodius University, Skopje, Republic of Macedonia*

Abstract

The industrial engineering consumes of materials and is dependent on a continuous supply of them. Increasing population and living standards cause the consumption rate to grow - something it cannot do forever. Finding ways to use materials more efficiently is a prerequisite for a sustainable future. Recent global attention to the issues and challenges of sustainable development is forcing industries to conduct self-assessments to identify where they stand within the framework for sustainability, and more importantly, to identify opportunities, strategies and technologies that support achieving this goal. Design for environmental sustainability is the long-term view: that of adaptation to a lifestyle that meets present needs without compromising the needs of future generations.

The composite material is a group of materials which they have not yet gained the same amount of utilisation as metallic materials. Since the composites consist of a mixture of several types of materials on macro level they cannot be regarded as homogenous as the steel materials. Both these circumstances complicate the possibilities to form a well-organised system for waste handling. The increased use of composites in industry will create continuously more waste to be handled in the future. Also for this type of materials several regulations put pressure on producers to consider the waste treatment. Examples are prohibition against landfill, producer responsibility for specific groups of products and eventually taxes on waste incineration. All these regulations are aiming for material recycling, due to decreased environmental impact. A common opinion is that recycling composite materials will be especially difficult or not even possible. The main alternative used today for handling composite waste is landfill but also waste incineration is an alternative. To respond to environmental awareness in society and to regulations, companies require new methods for waste disposal.

Key words: *environmental effects, eco-design, composites, waste.*

The rapid increase of human activities industrial revolution } huge quantities of resources and energy

The mass consumption and the large production has significant influences on the earth's ecology, exhausting non-renewable resources and causing some environmental problems by polluting the air, water and soil.

The current pattern of unsustainable development has forced many segments of society to come together in facing a critical challenge:

How can societies across the world meet their current basic human needs, aspirations and desires, without compromising the ability of future generations to meet their own needs?

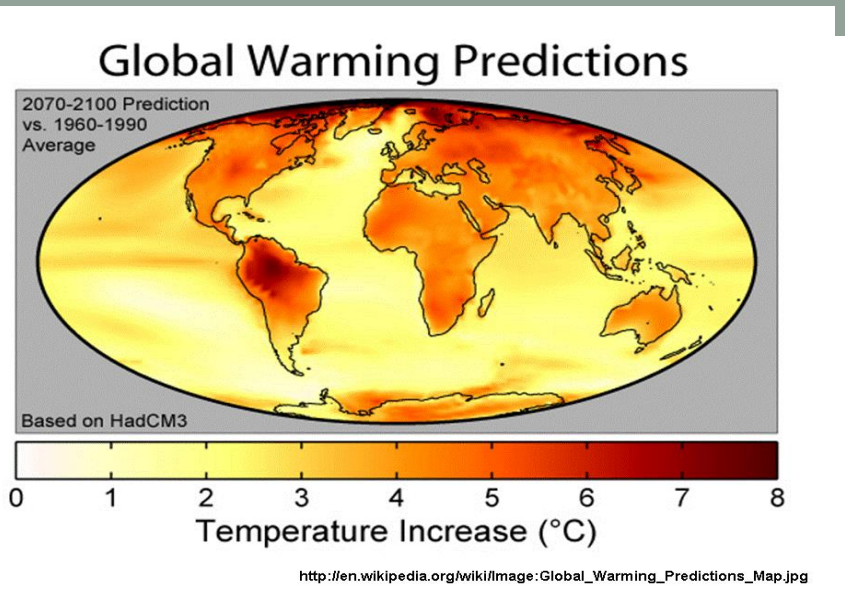
- We are consuming large part of the natural resources available to us on this planet !
- We are creating sufficiently large amounts of waste and pollution !

The earth can no longer assimilate our wastes and recover from the negative impacts !!!!!

This is a result of a growing population as well as new technologies which make it easier for us to access natural resources and also require the consumption of more resources.

The main ecological world problem of Climate change and global warming

Sustainable development of the materials and technologies



"The atmosphere doesn't recognize company expansion or company balance sheets, it only recognizes CO_2 molecules"

Roger Higman, Chemistry & Industry

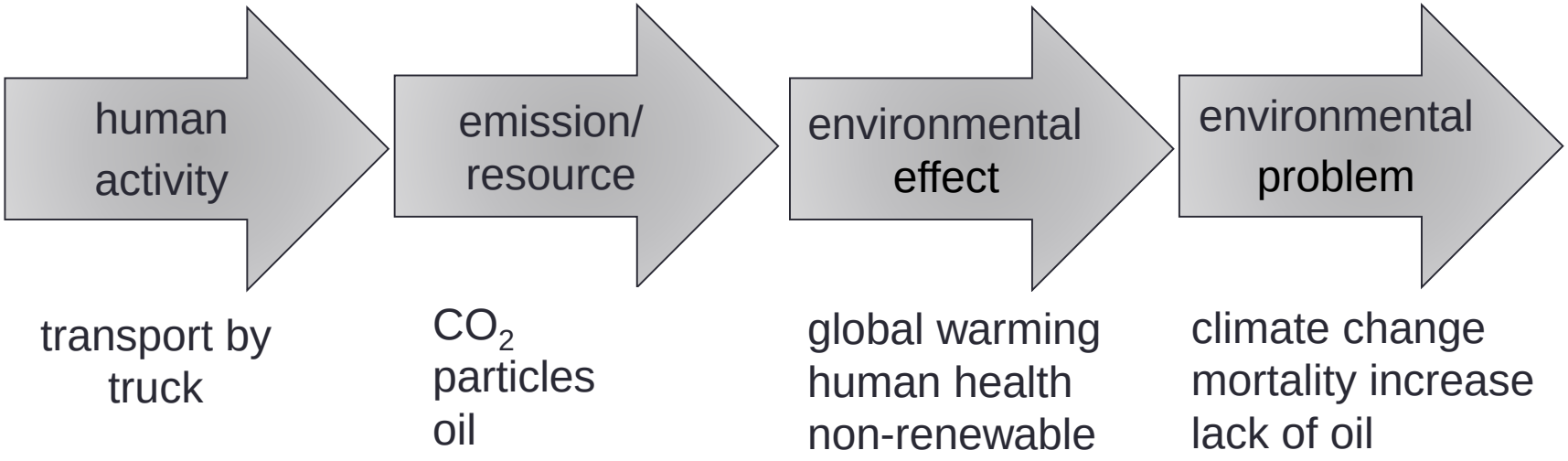
Technology - very important role in sustainable development !

It is one of the most significant ways in which we interact with our environment;
We use technologies to extract natural resources, to modify them for human purposes, and to adapt our man-made living space.

Unsustainable technology has been the result of linear rather than cyclic thinking.

The paradigm shift from linear to cyclic thinking in technological design is the crux of the shift from unsustainability to sustainability.

Environmental context



The chain of events resulting in environmental problems

The materials life cycle

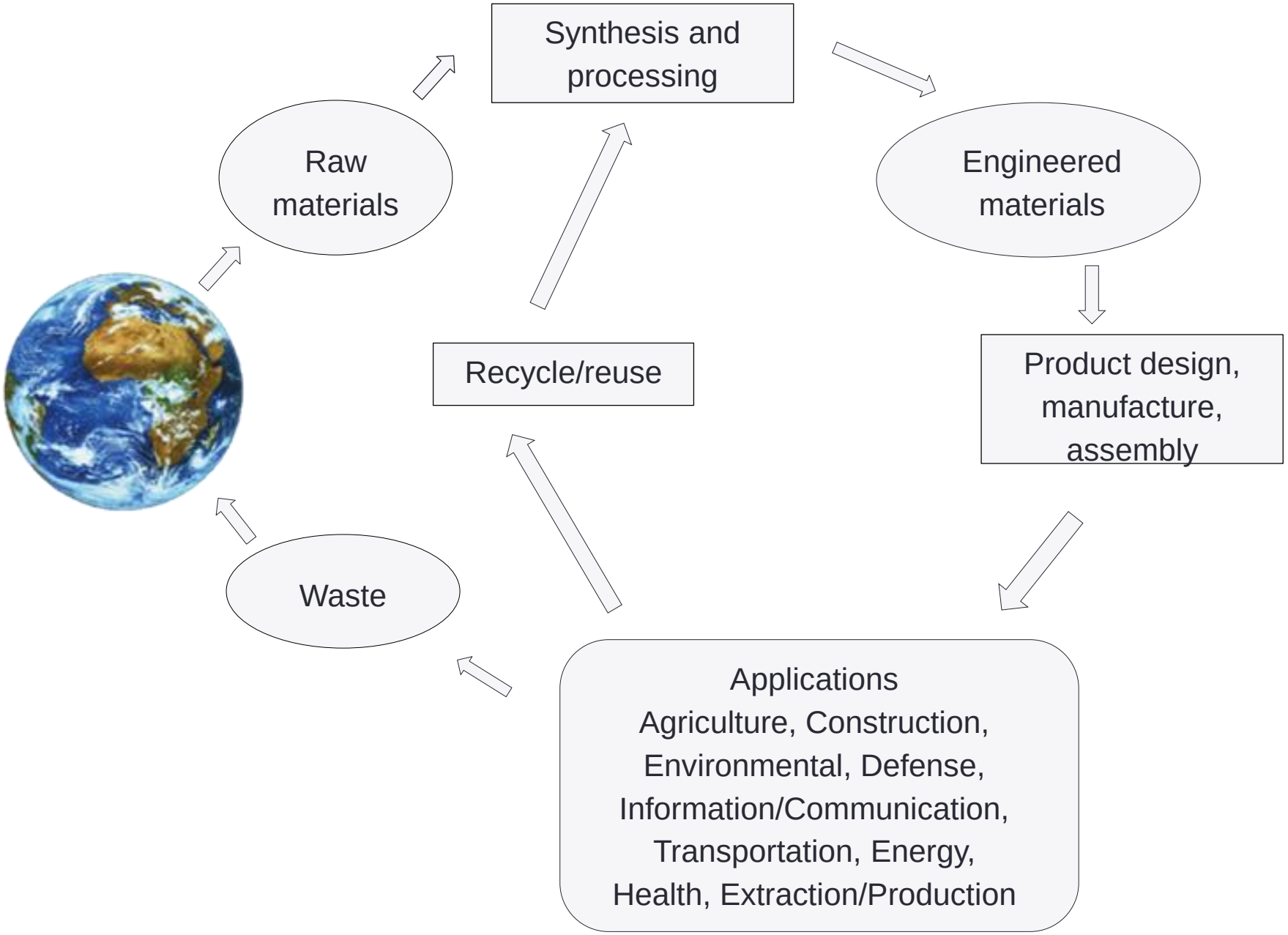
From the earth's ***resources - materials - products***

At the end of product lives:

- discarded,
- a fraction perhaps entering a recycling loop,
- the rest committed to incineration or landfill.

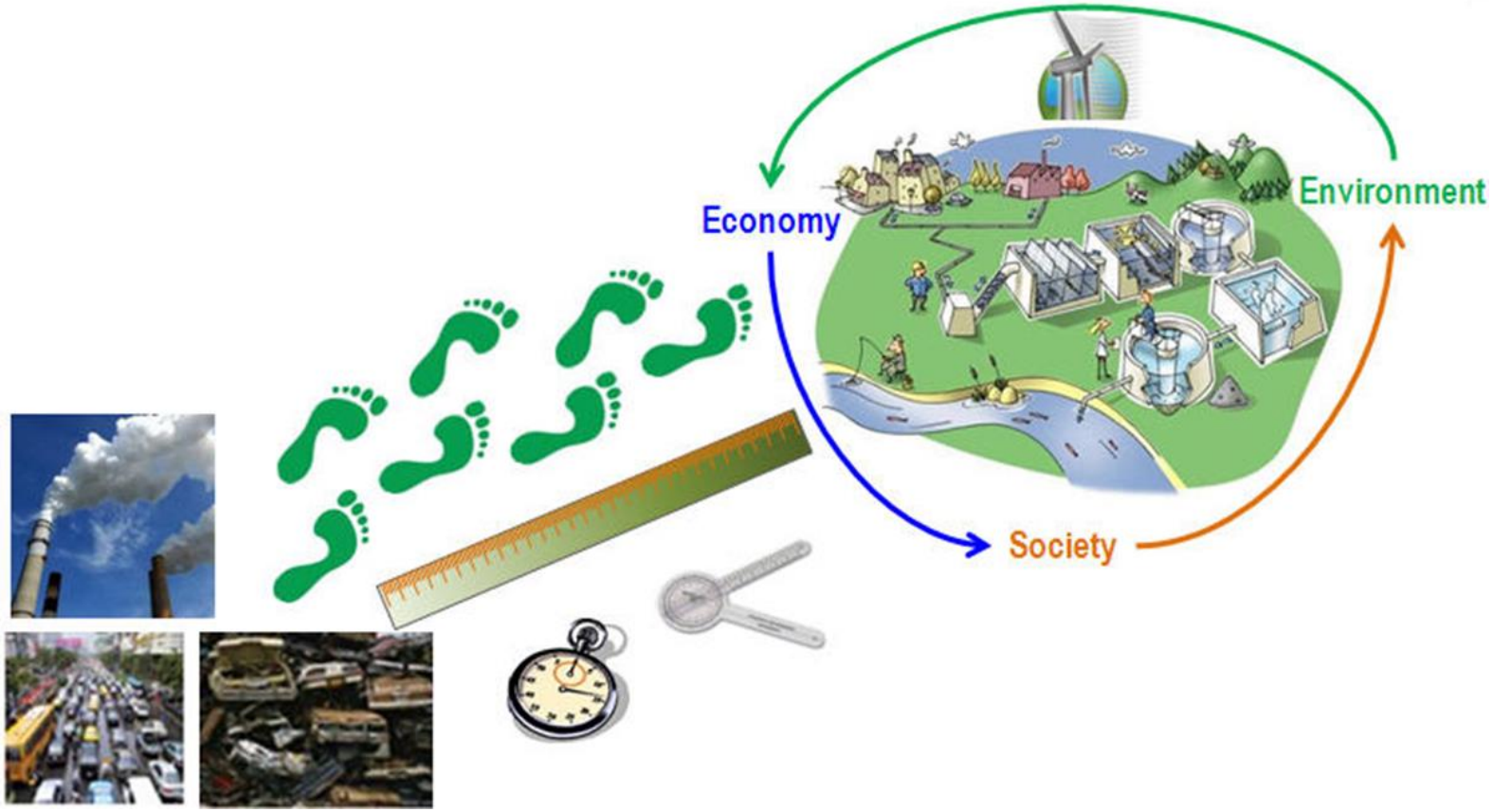
Materials play a crucial role in technology-economy-environment scheme. A material that is utilized in some end product and then discarded passes through several stages or phases.

These stages sometimes are termed the ‘‘total materials cycle’’ or just ‘‘materials cycle’’ and represents the life circuit of a material.


Synthesis and processing
Raw materials
Engineered materials
Recycle/reuse
Product design, manufacture, assembly
Waste
Applications
Agriculture, Construction, Environmental, Defense, Information/Communication, Transportation, Energy, Health, Extraction/Production

Selecting materials for eco-design

Which phase of the life cycle of the product under consideration makes the largest impact on the environment?



The environmental consequences of the final phase of product life have many aspects or requirements which are summarized in the following guidelines:

Toxicity - it means that avoiding toxic materials such as heavy metals and organometallic compounds is good because they in landfill, cause long term contamination of soil and groundwater.

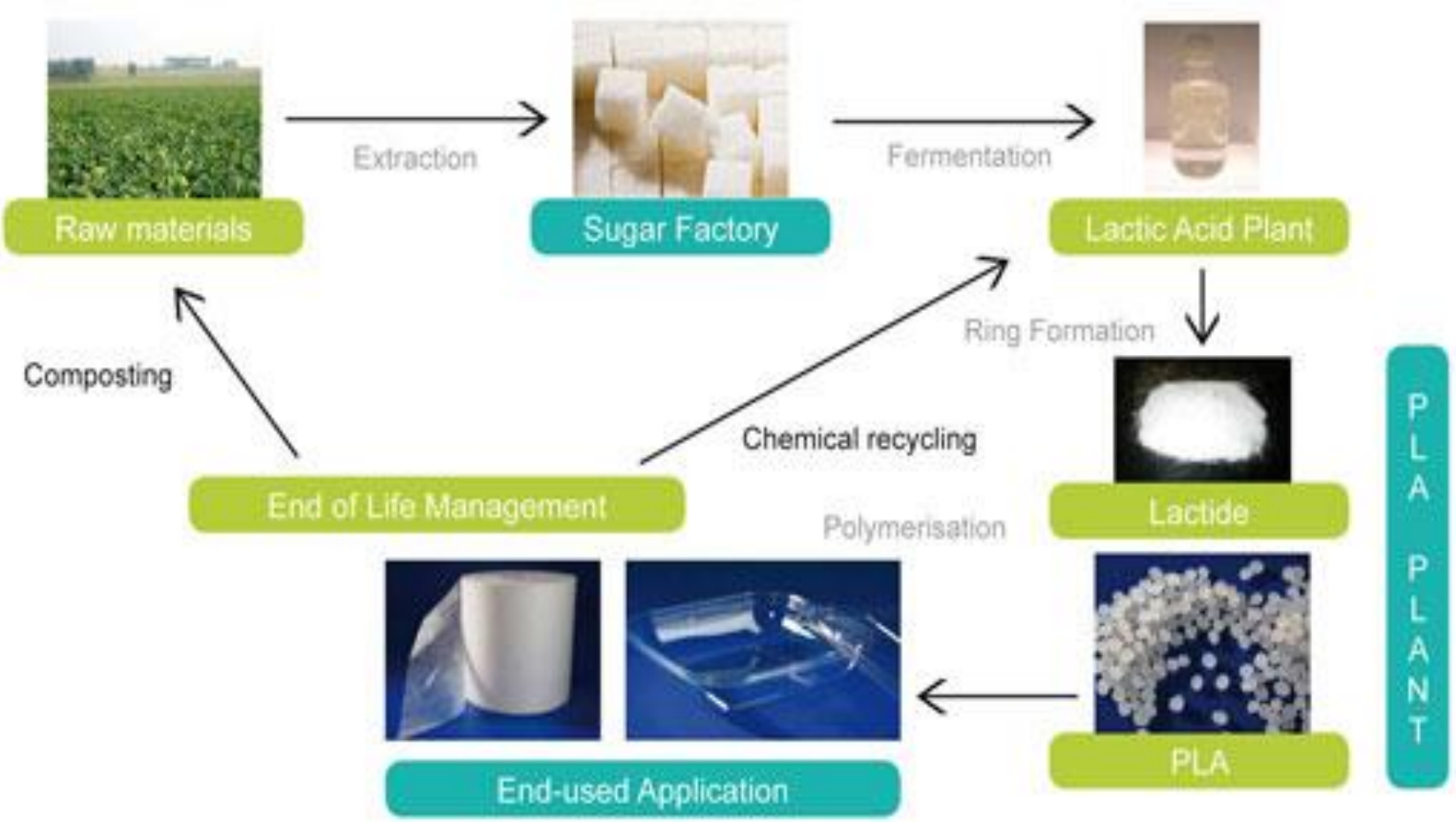
Potential of recycling - it means examination the using of materials that cannot be recycled, since recycling can save both material and energy and to minimize recycling of materials for which this is possible.

Controlled combustion - when recycling is impractical the best way is to recover energy by controlled combustion.

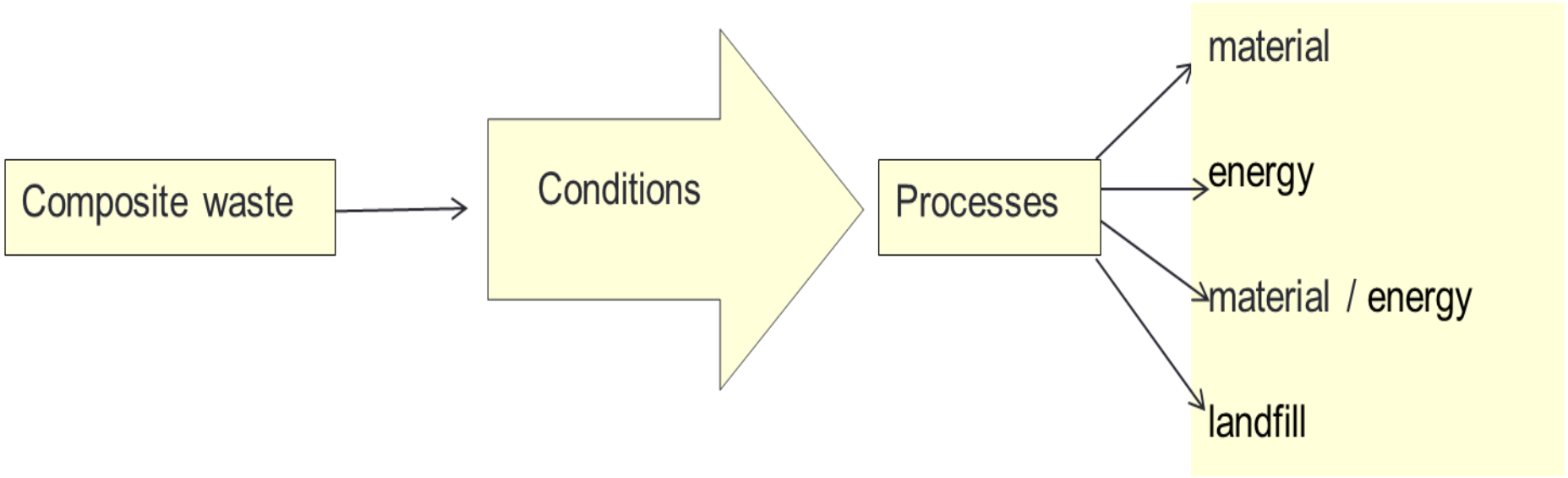
Biodegradability - it means the using of materials that are biodegradable or photo - degradable, although these are ineffectual in landfill because the anaerobic conditions within them inhibit rather than promote degradation.

Methods of end of life treatment: state of the art

The methods are divided into the following groups: **1. reuse; 2. mechanical material recycling; 3. energy recovery; 4. material recycling and energy or chemical recovery.**



A model for treatment of composite waste



Conclusion

Because of increasing environmental demands, especially on dealing with products end of life phase, product manufacturers and designers must consider the future disposal of their products. For conventional materials like steel and aluminium well-functioning recycling methods exists. This is not the case for structures of composites, which are used more extensively. The composites consist of a mixture of several types of materials on macro level and they cannot be regarded as homogenous as the steel materials. These circumstances complicate the possibilities to form a well-organised system for waste handling. Several techniques do exist but they are not yet commercially available. The current disposal methods of composites are landfill and incineration. Many investigations have pointed out recycling of composite materials as the best alternative considering environmental effects. Since recycling composites is a complicated process, especially recycling polymer composite it is important to acquire comprehensive information about the constituents of these materials.