Life Cycle Assessment
Age range: 13-16 years

LIFE CYCLE ASSESSMENT OF MATERIALS

This lesson plan provides further examples of life cycle assessment in regard to comparison of building materials and explores the most circular approach.

LESSON OBJECTIVES

Students will be able to:

- Complete life cycles for various materials
- Compare the environmental impact of materials

SUMMARY OF TASKS

PART 1 –THE STEEL/CONCRETE INDUSTRIES

- Play a quick game of Pictionary to recap with students, get them to draw out a product consumption cycle and each of the 'Cradle-to-X' phrases
- Introduce students to the steel/concrete industries
- Ask students to draw out the life cycle of steel and concrete and discuss if these are circular materials – *you can use the prompt questions from 'Product Life Cycle Assessment' activity sheet*

PART 2 – THE WOOD INDUSTRY

- Introduce students to the wood industry
- Ask students to draw out the life cycle of sustainable wood and discuss if this is a circular material, consider the carbon inputs and outputs involved – *can use the prompt questions from 'Product Life Cycle Assessment' activity sheet*

PART 3 – DISCUSSION

- Complete 'Circular Materials' activity sheet in pairs and feedback to the class
- Discuss (1) What is the most circular material? (2) What material has the biggest impact on the environment? (3) What could future houses look like in a circular economy?

RESOURCES/ EQUIPMENT

- 'Life Cycle Assessment of Materials' fact sheet
- 'Circular Materials' activity sheet
- 'Product Life Cycle Assessment' activity sheet

HOMEWORK/ EXTRA ACTIVITIES

- Students could research LCA of other building materials e.g. aluminium or glass

FACT SHEET: LIFE CYCLE ASSESSMENT OF MATERIALS

FACT SHEETS HAVE BEEN DESIGNED FOR TEACHER USE TO AID CREATING OF TEACHING RESOURCES, OR THEY ARE FREE TO BE REPURPOSED FOR STUDENT USE.

Life cycle assessments consider the environmental impact of a product for its entire life including the extraction of raw materials, manufacturing process, use of product and its end of life treatment.

PART 1 – THE STEEL & CONCRETE INDUSTRIES

The steel and cement industries have one of the largest carbon footprints in the materials industry due to the high energy requirement involved in making these materials.

Steel is a widely used material with many applications in the automotive, packaging and construction industries. Worldsteel is a global steel organisation and gives guidelines for companies to carry out LCA by considering the following:

- Extraction of resources and use of any recycled materials
- Production of steel
- End of life recovery and recycling of steel[1]

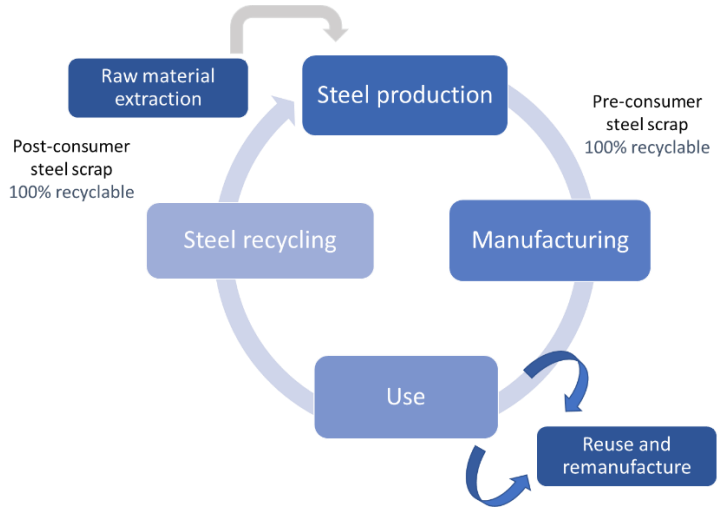


Figure 1: LCA for the steel industry[1]

[1] https://www.worldsteel.org/en/dam/jcr:22f5ed93-0311-4f8a-a90c-b9ac424a3d01/LCA%2520position%2520paper.pdf

Steel meets all the requirements for a circular material because the products are durable, can be repaired to extended their life and can be recycled at their end of life, which means closing the loop.

Concrete is primarily made up of water, sand, stone, and gravel. The extraction and processing of these materials requires little energy and has a relatively small carbon footprint. However, concrete also uses between 7-15% cement by mass which has a much larger carbon footprint and around 100-300 kg of carbon dioxide is produced for every cubic meter of concrete. Therefore, extensive efforts are made to recycle concrete and cement by making reusable aggregates.[2]

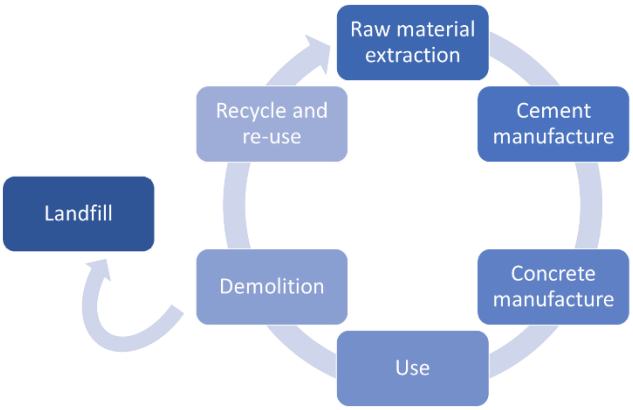
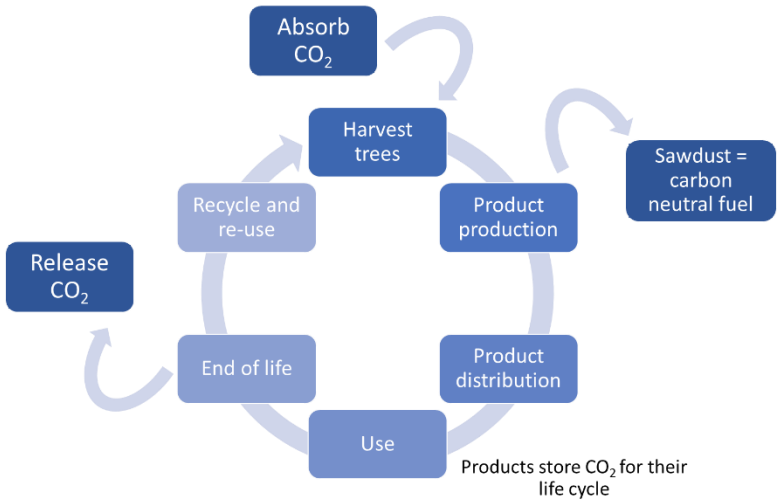


Figure 2: LCA for concrete

PART 2 – THE WOOD INDUSTRY

The wood indsutry uses much less energy than the manufacturing of most other materials, however the drying process can be energy intensive. Reforestation and sustainable forest management are important factors to consider if producing a very low carbon footprint material. Atmospheric CO_2 is absorbed and stored in the wood for its entire life cycle until its decay. The manufacturing process of wood produces sawdust as a residue which can be used as a carbon neutral fuel.[3]



[2] https://www.nrmca.org/sustainability/CSR04%20-%20Life%20Cycle%20Assessment%20of%20Concrete%20Buildings.pdf
[3] https://www.canadianwood.in/a-quick-lowdown-on-lca-of-building-materials-and-why-wood-emerges-as-a-winner/

Figure 3: LCA for wood

ACTIVITY: CIRCULAR MATERIALS

Instructions

Please see the web page for more information about Life Cycle Assessment and Circular Economy.

This activity is intended to prompt thinking and discussion about building materials and their life cycles.

This activity is intended to be used alongside the 'Life Cycle Assessment of Materials' lesson plan.

Task

If you are based in a classroom

Students should already be familiar with life cycle assessment and sustainability factors.

Students should complete this essay based activity using the resources provided and be able to defend their conclusions.

If you are doing this activity at home

The student could do this as a stand-alone activity and answer the questions using different resources available.

Additional resourcees

- https://woodforgood.com/news-and-views/2019/04/01/transforming-construction-building-the-uks-circular-economy/
- https://www.canadianwood.in/a-quick-lowdown-on-lca-of-building-materials-and-why-wood-emerges-as-a-winner/

These resources will aid students in learning about building materials in a circular economy.

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1. WOOD VS. STEEL VS. CONCRETE

Using the resources given and information from this lesson, compare the environmental impact of wood, steel and concrete. Complete a life cycle assessment for each material, including inputs and outputs considering the following factors:

- Energy usage
- Resource use
- Impact on global warming
- Negative implications of acidification, ozone depletion and smog formation.

What are the futures of these materials in a circular economy?