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ENVIRONMENTAL CHALLENGES AND OPPORTUNITIES OF LIGNIN

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WHAT ABOUT LIGNIN?

- Lignin is the most abundant bio-polymer on earth
  - Glues hemicellulose and celluose together
  - Provides stiffness to the stem of plants and trees
- Can be extracted from side streams in biorefineries and pulp mills
  - Is today mainly used for internal energy use
- Has many possible applications
  - For example as a raw material for chemical production or as a fuel precursor

WHY THE INTEREST IN LIGNIN?

- The LIBRE project aims to produce carbon fibers from lignin
  - Carbon fibers are usually produced from polyacrylonitrile
- We soon noticed that little work had been done on how to assess lignin using LCA
  - We also noticed that the choice of allocation method affect the final results for the carbon fiber significantly
  - We decided look into how lignin is best assessed using LCA
  - How do you assess a material with an emerging market?

AIM OF THIS STUDY:

- To assess and illustrate how different allocation methods in life cycle assessment affect the resulting environmental impacts for lignin and the final application

SCOPE OF THE STUDY

- Funtional unit: 1 kg of lignin from Kraft pulping in Sweden
- System boundary: Cradle-to-(pulp mill) gate
- Impact category: Climate impact

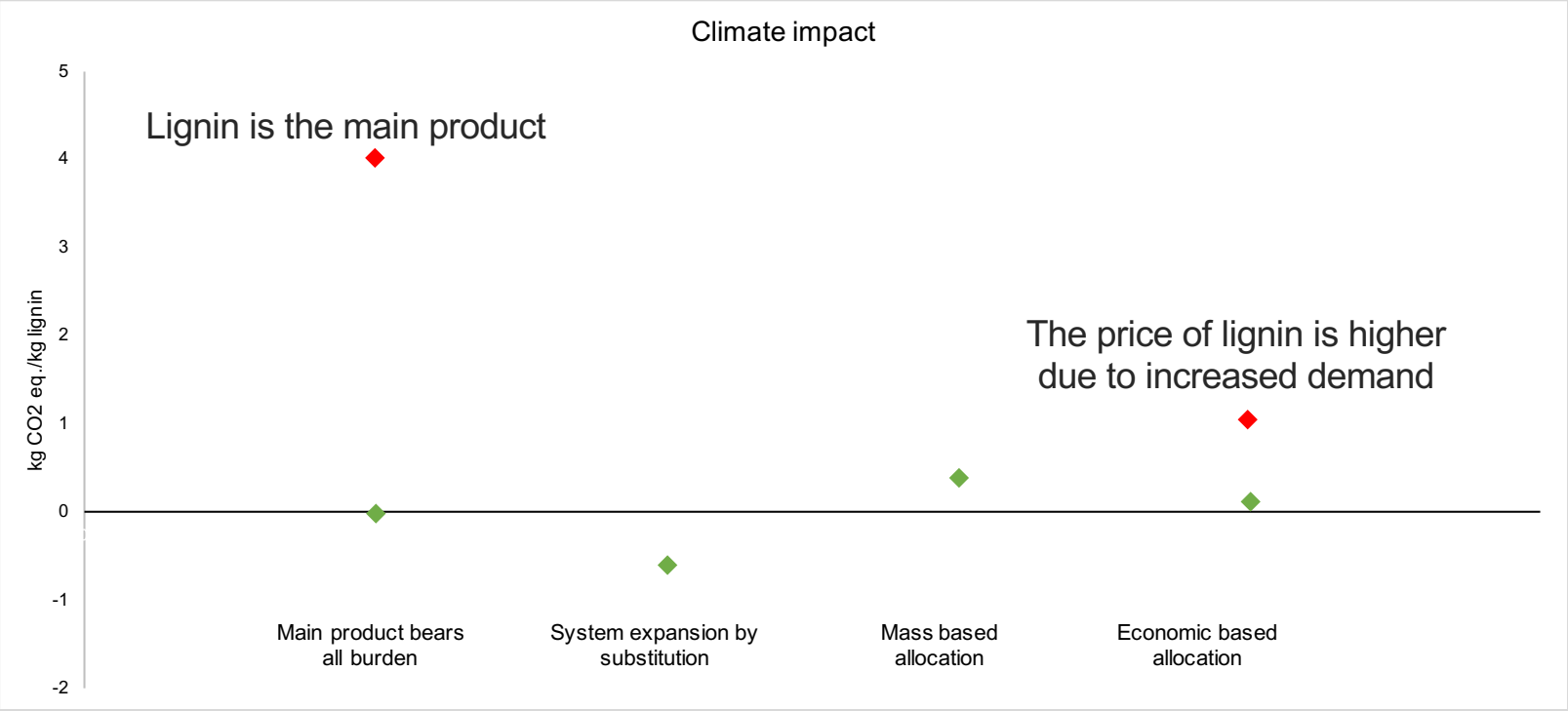
SCOPE OF THE STUDY: INVENTORY DATA

- Inventory for lignin production is from Culbertson et al. (2016)
  - Adapted to fit Swedish conditions
  - Outputs are:
    - Pulp
    - Lignin
    - Soap
    - Heat

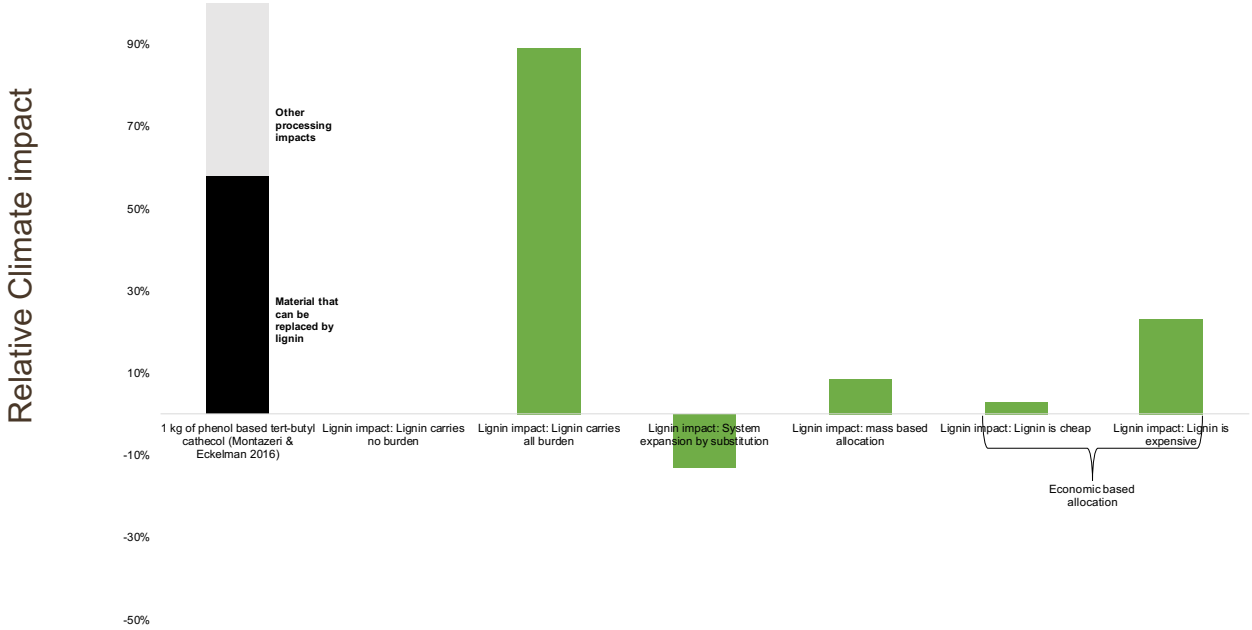
WE ASSESSED THE FOLLOWING ALLOCATION METHODS

- Main product bears all burden (as described by Sandin et al. 2015)
- System expansion by substitution (as described by Sandin et al. 2015)
- Mass allocation
- Economic allocation

RESULTS: DIFFERENT ALLOCATION METHODS GIVES DIFFERENT RESULTS



RESULTS: WHAT DOES THIS MEAN IN PRACTICE?



CONCLUSIONS AND LIMITATIONS

- The choice of allocation method has a large influence on the environmental impact of lignin and on the impact of the end product
- The drivers of the system changes also has a large influence
  - These could change and vary with time
- Limitations:
  - These results are for one specific process-More data are needed!
  - It is difficult to predict what is going to happen in e.g. the future
  - What are good substitutions?

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