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IEA Bioenergy
Technology Collaboration Programme

Task 42: Biorefining in a Circular Economy

Net zero biorefineries oriented to high-value products

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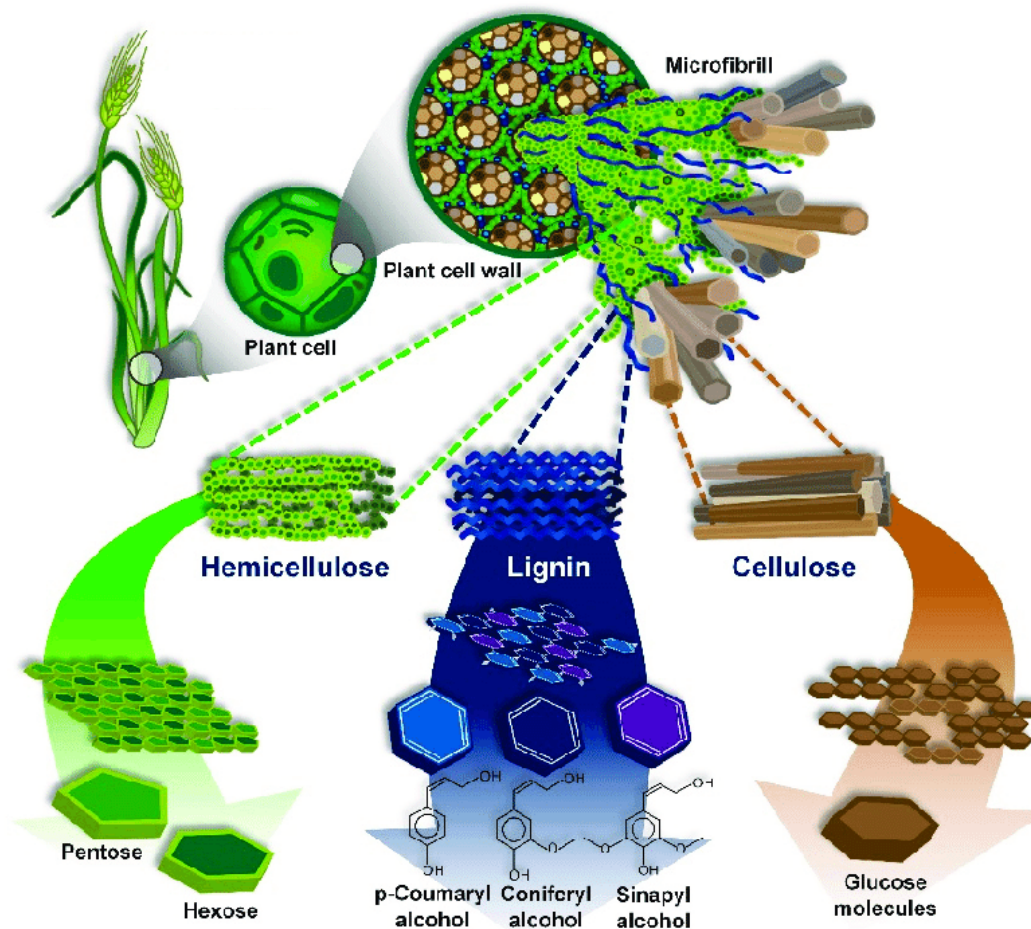
Biorefinery: Feedstocks



Images taken from: <https://pixabay.com/>

Biorefinery: Feedstocks

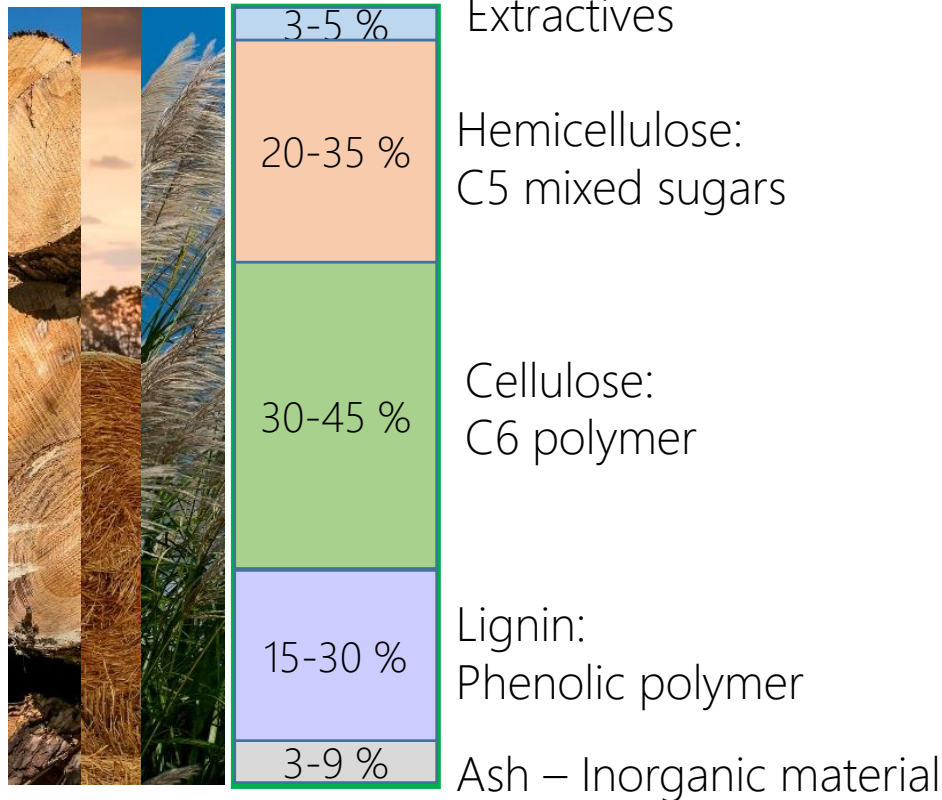
Structure of
lignocellulosic biomass



Ref: Hernández-Beltrán et al., 2019

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Biorefinery: Feedstocks

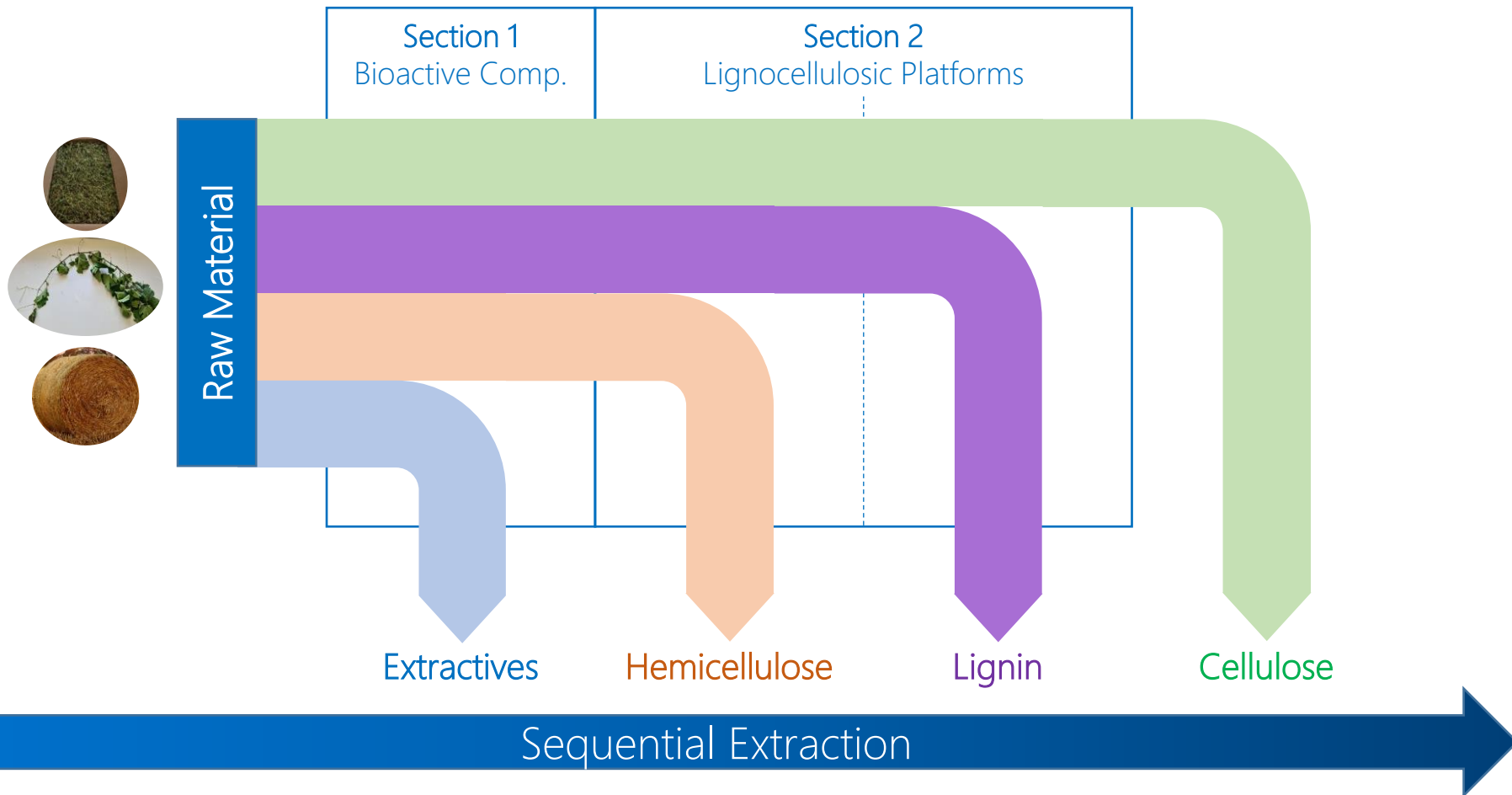


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- Goal of pretreatment
 - Mobilisation of components
- Steps
 - Extractives
 - Hydrolysis of hemicellulose
 - Dissolution of lignin
 - Cellulose kept in good quality
- Targets
 - High quality products
 - 100% valorisation
 - Low energy demand
 - Low investment and running costs

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Biorefinery: TU Wien Approach



Biorefinery: Pretreatment and Conversion Technologies

- Mechanical treatment (mechanical pulping)
 - Chemical pretreatment (chemical pulping)
 - Sulfite (SPORL)- or Sulfate (Kraft)- cooking
 - OS, LHW, DES, PAA
 - Biochemical conversion
 - Thermochemical conversion
-  TU Wien approach
-  TU Wien approach
-  TU Wien approach

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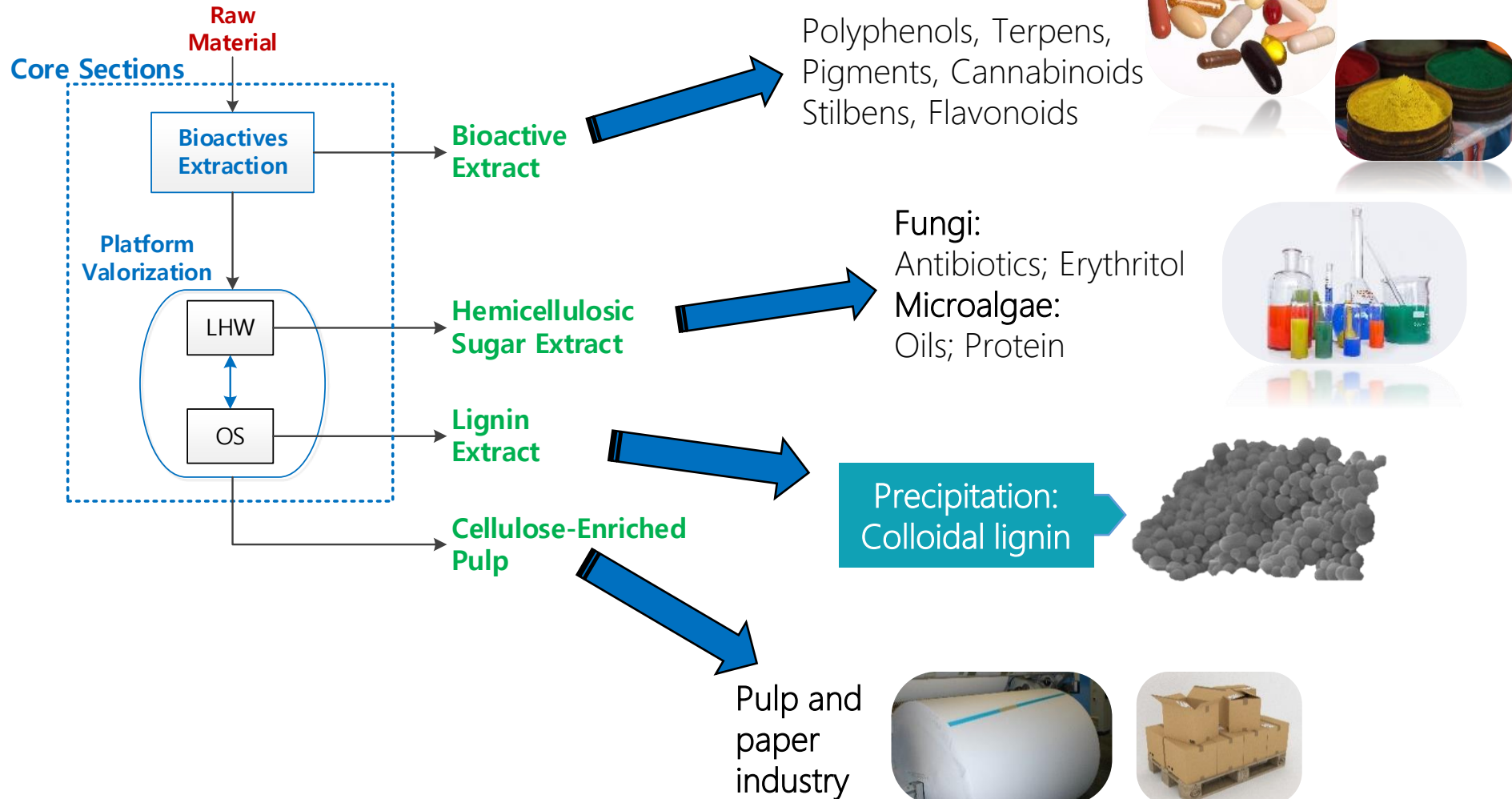
Biorefinery: TU Wien Approach



- Extractor Volume 1, 3.7, 10 Liter
- 220°C / 30 bar
- Hydrothermal processing – (LHW, OS, Soda, etc.)

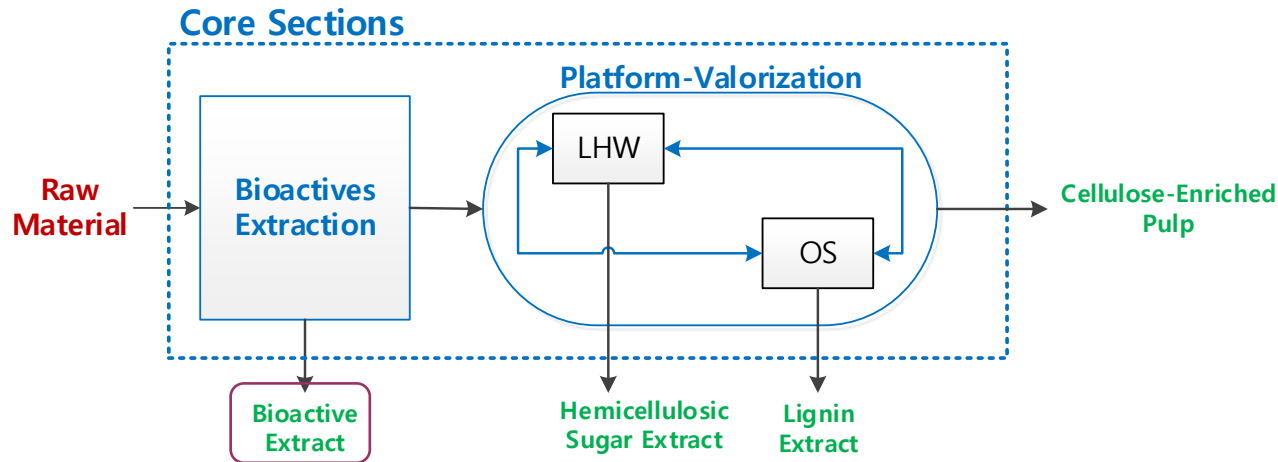
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Serna-Loaiza, S.; Kornpointner, C.; Pazzaglia, A.; Jordan, C.; Halbwrith, H.; Friedl, A. Biorefinery concept for the valorization of grapevine shoots: Study case for the Austrian variety Grüner Veltliner. *Food and Bioproducts Processing* 2022, In Press.



Pressurized Liquid Extraction of Cannabinoids from Hemp Processing Residues: Evaluation of the Influencing Variables

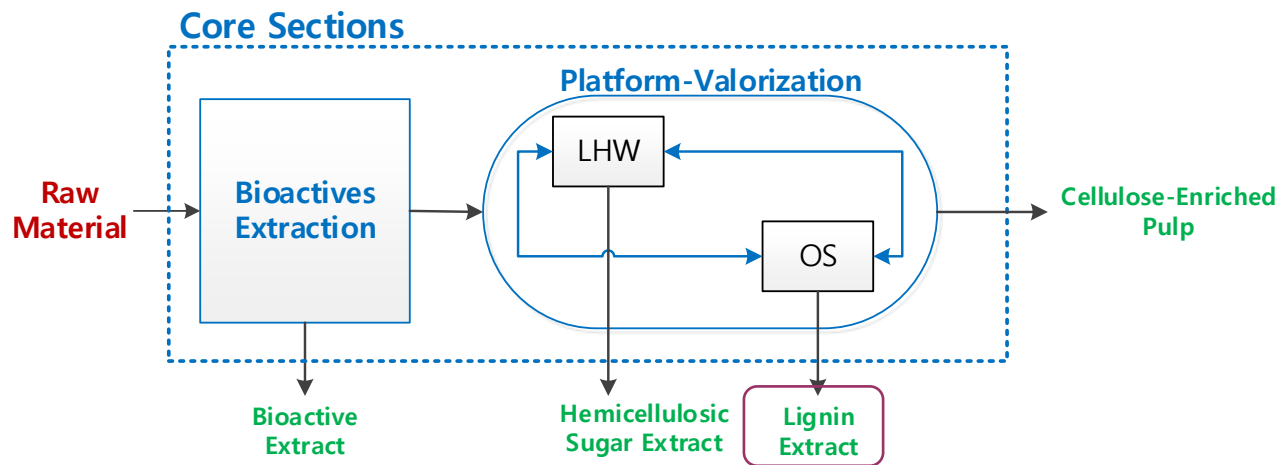


processes

by Sebastián Serna-Loaiza * , Johannes Adamcyk , Stefan Beisl , Christoph Kornpointner ,
 Heidi Halbwrith and Anton Friedl

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Direct Precipitation of Lignin Nanoparticles from Wheat Straw Organosolv Liquors Using a Static Mixer

by Stefan Beisl^{*} Johannes Adamczyk and Anton Friedl



molecules

Production and Properties of Lignin Nanoparticles from Ethanol Organosolv Liquors—Influence of Origin and Pretreatment Conditions

by Johannes Adamczyk^{1,*} Stefan Beisl^{1,2} Samaneh Amini¹ Thomas Jung¹ Florian Zikeli¹ Jalel Labidi² and Anton Friedl¹



polymers

Production of Micro- and Nanoscale Lignin from Wheat Straw Using Different Precipitation Setups

by Stefan Beisl^{*} Petra Loidolt Angela Miltner Michael Harasek and Anton Friedl



molecules

Influence of Temperature and Lignin Concentration on Formation of Colloidal Lignin Particles in Solvent-Shifting Precipitation

by Johannes Adamczyk^{*} Sebastian Serna-Loaiza Stefan Beisl Martin Miltner and Anton Friedl



sustainability

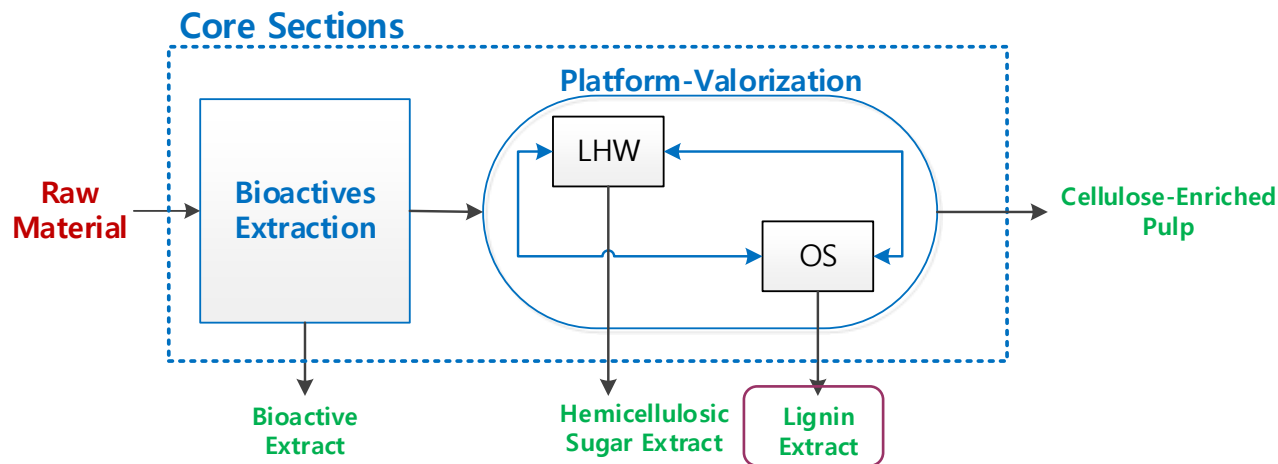
Enhanced Cellulose Degradation of Wheat Straw during Aqueous Ethanol Organosolv Treatment

Martin Lindemann, Anton Friedl, Ewald Srebotnik

BioResources

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Biorefinery: TU Wien Approach



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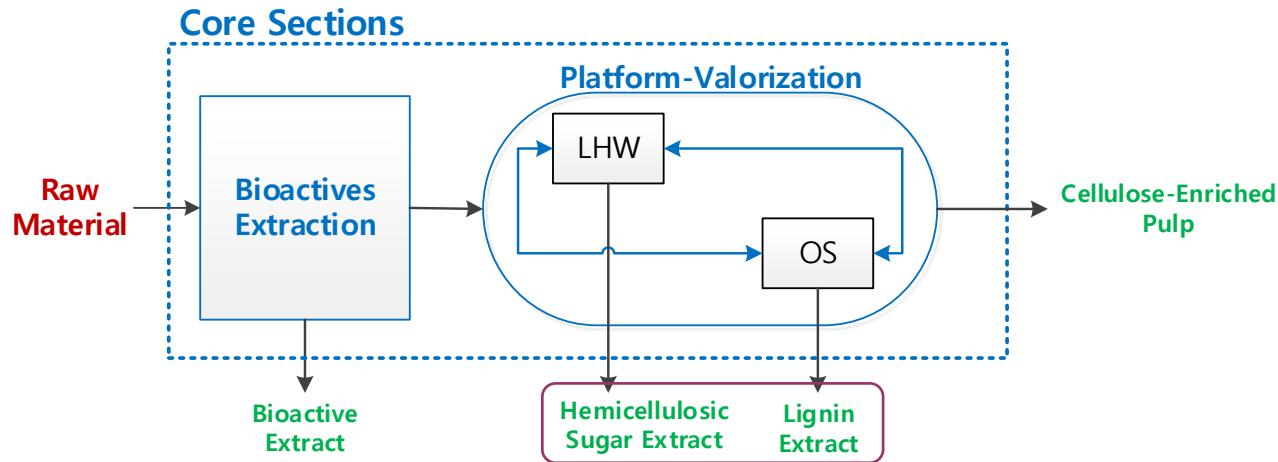
[Sebastian Serna-Loaiza](#) , [Stefan Beisl](#) , [Martin Miltner](#) and [Anton Friedl](#)



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Integral Analysis of Liquid-Hot-Water Pretreatment of Wheat Straw: Evaluation of the Production of Sugars, Degradation Products, and Lignin



by Sebastian Serna-Loaiza^{1,*}, Manuel Dias^{2,3}, Laura Daza-Serna¹,
Carla C. C. R. de Carvalho^{2,3} and Anton Friedl¹



Bioresource Technology Reports
Volume 14, June 2021, 100667



Journal of Cleaner Production
Volume 245, 1 February 2020, 118760



Case study

Towards a wheat straw biorefinery: Combination of Organosolv and Liquid Hot Water for the improved production of sugars from hemicellulose and lignin hydrolysis

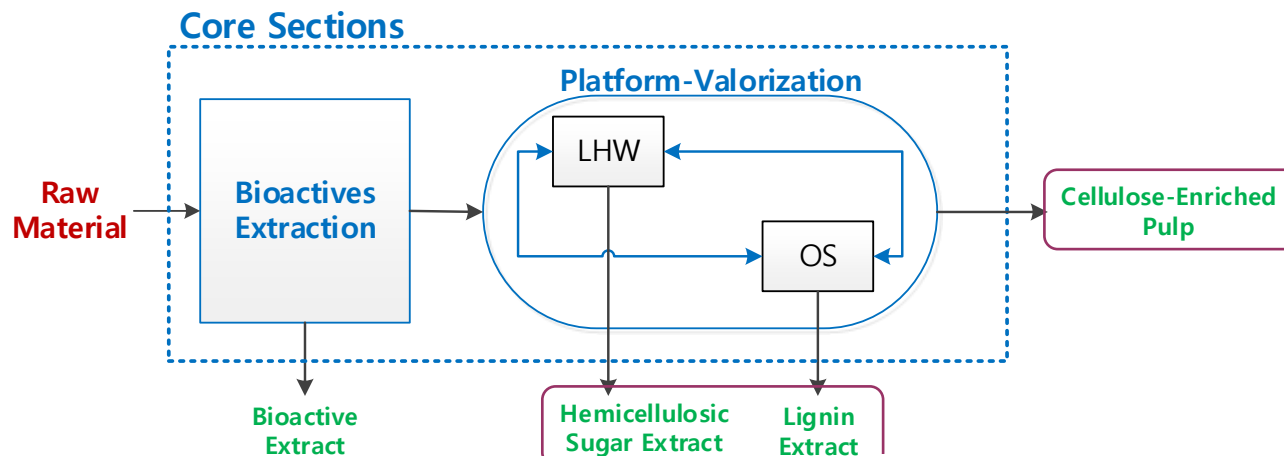
Sebastián Serna-Loaiza^{1,*}, Florian Zikeli, Johannes Adamczyk, Anton Friedl

Life cycle assessment of a lignin nanoparticle biorefinery: Decision support for its process development

Daniel Koch^{1,*}, Marco Paul, Stefan Beisl², Anton Friedl³, Bettina Mihályi⁴

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Biorefinery: TU Wien Approach



Waste and Biomass Valorization
<https://doi.org/10.1007/s12649-022-01824-8>

ORIGINAL PAPER

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Sequential Pretreatment of Wheat Straw: Liquid Hot Water Followed by Organosolv for the Production of Hemicellulosic Sugars, Lignin, and a Cellulose-Enriched Pulp

Sebastián Serna-Loaiza^{1,*}, Johannes Adamcyk¹, Stefan Beisl¹, Martin Miltner¹, Anton Friedl¹

Case study

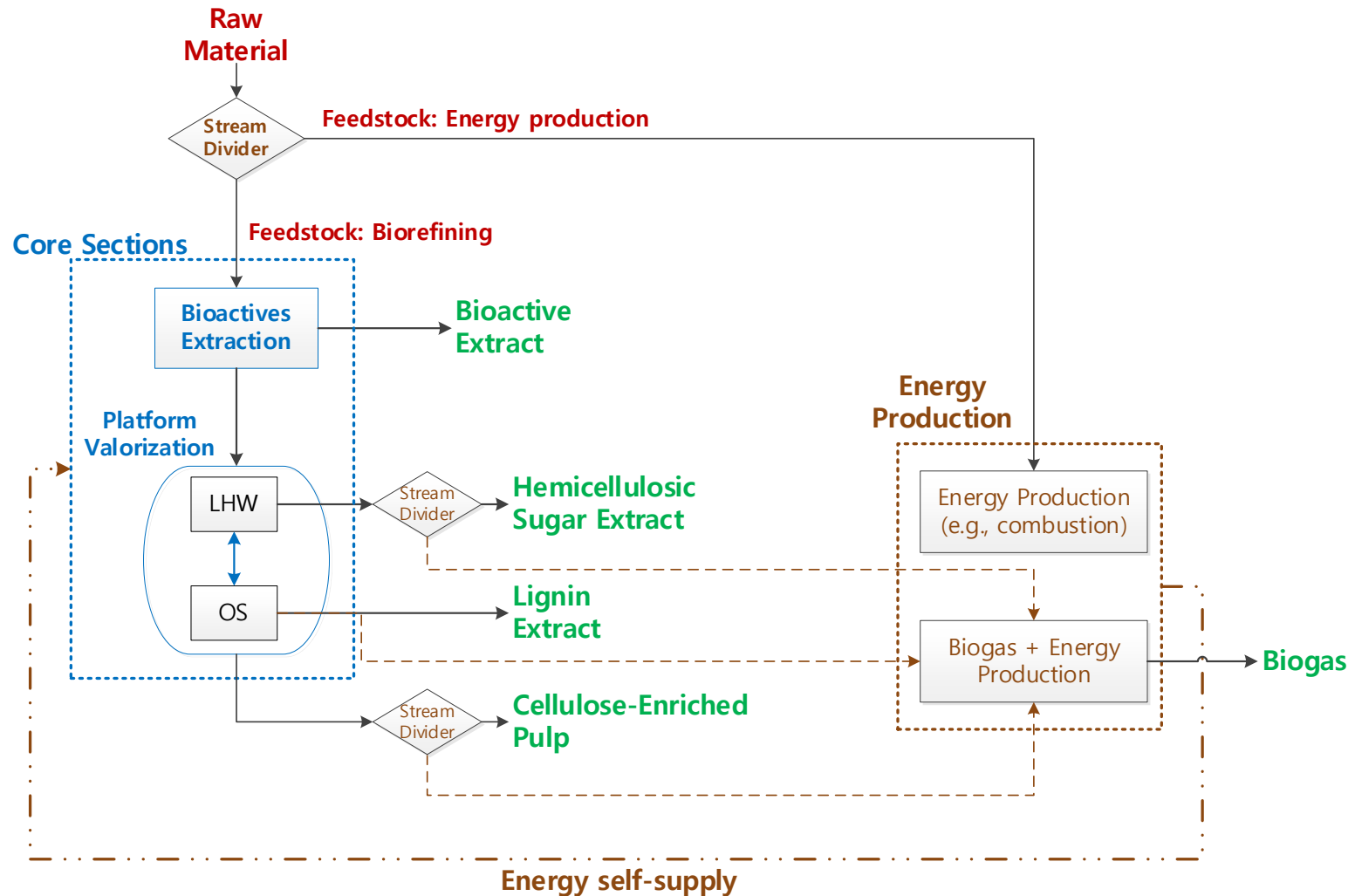
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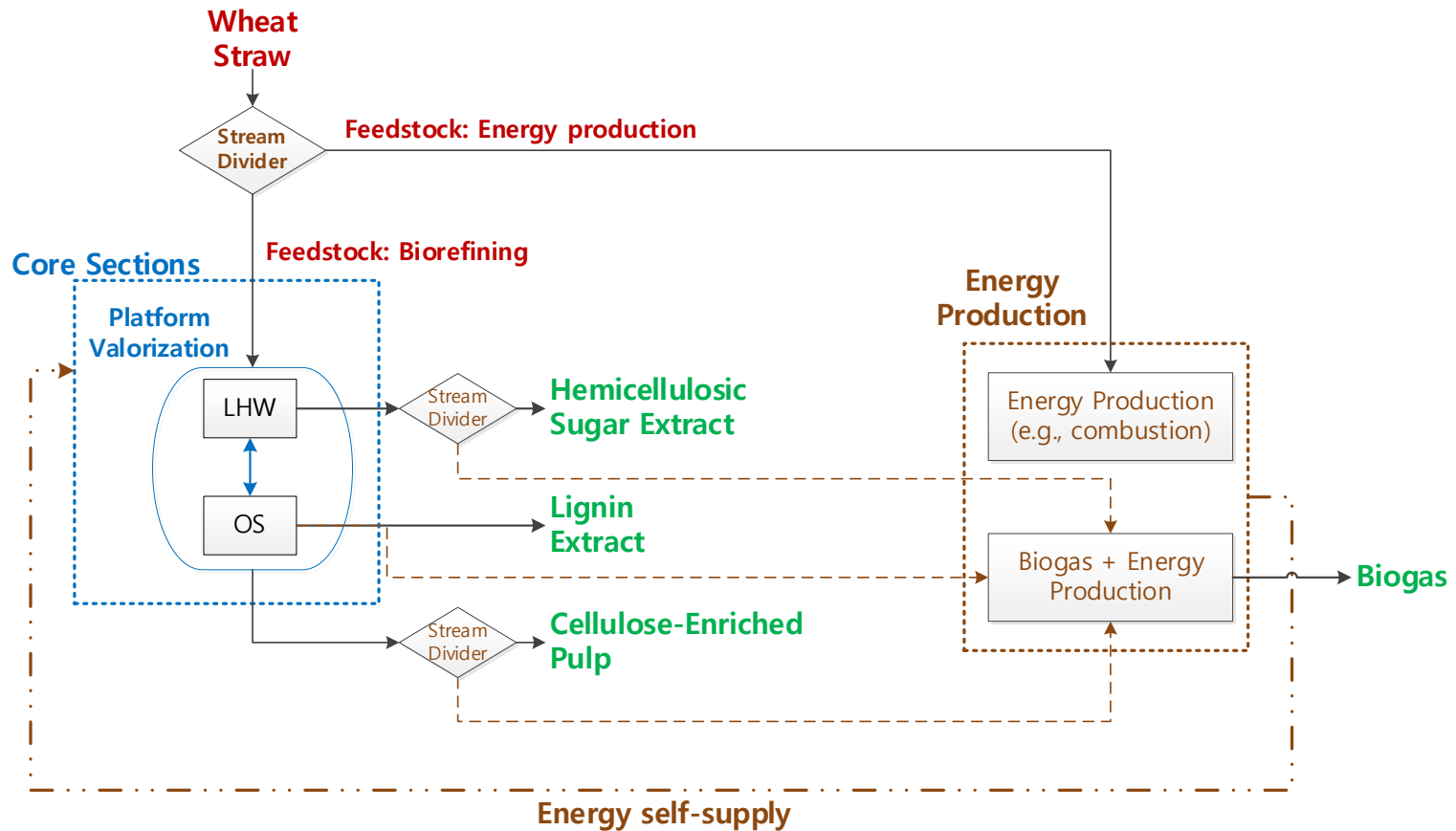
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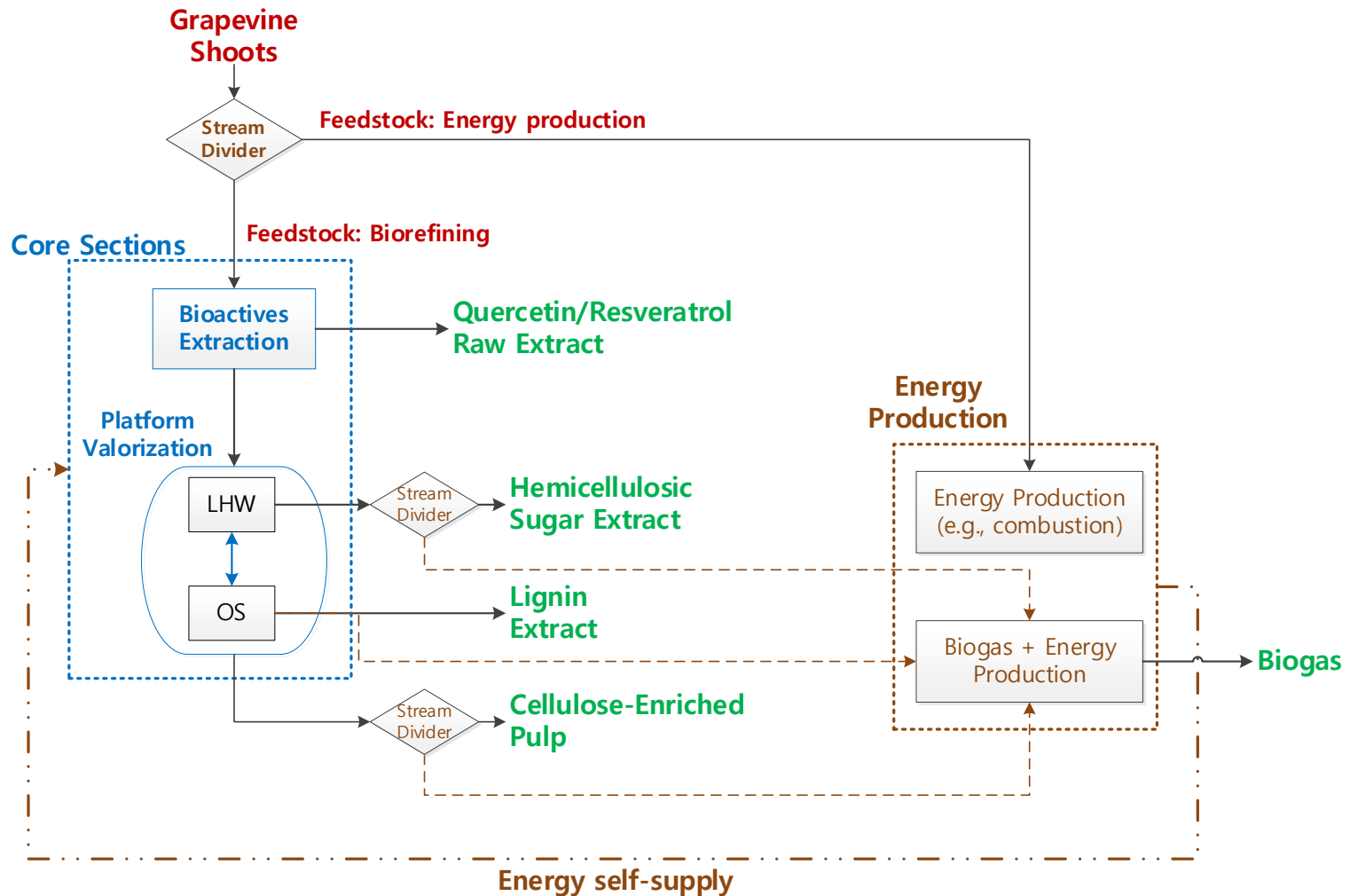
Closing the loop: Towards a self-sufficient biorefinery



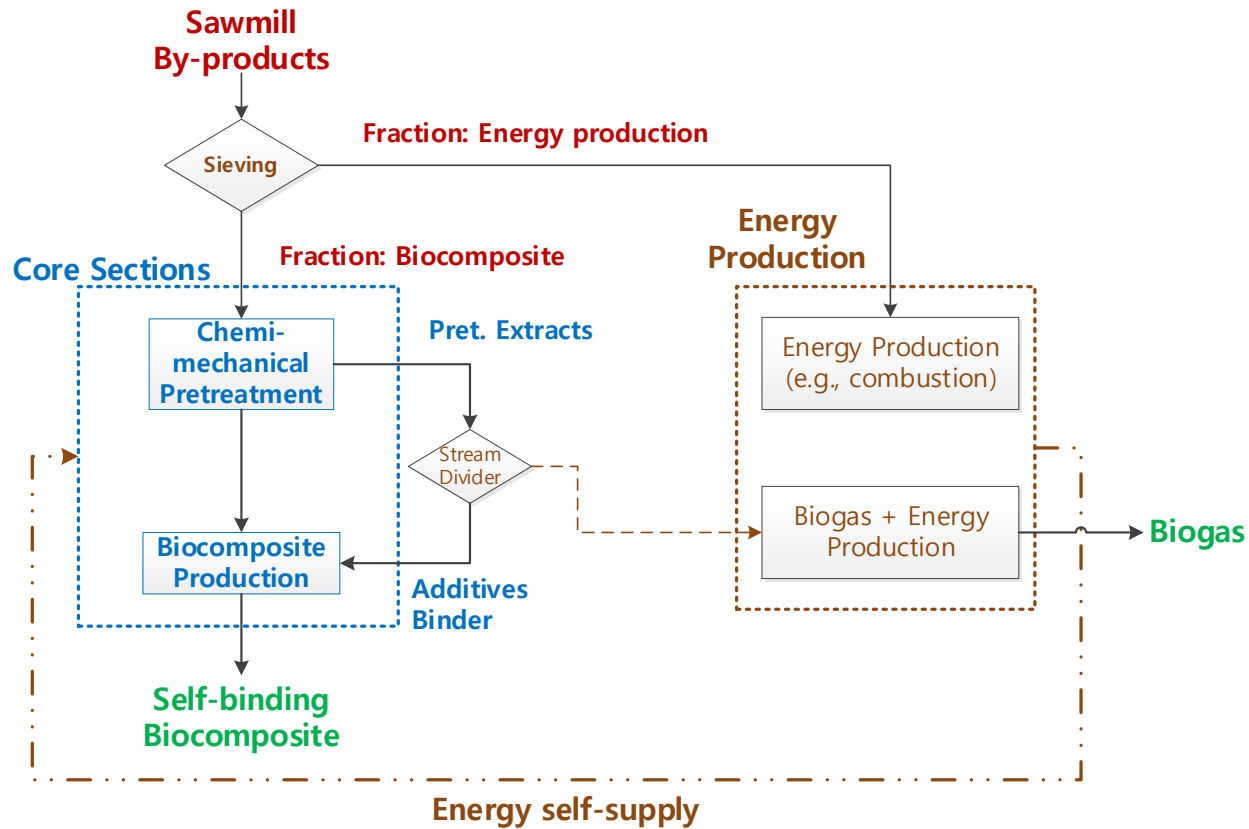
Closing the loop: Towards a self-sufficient biorefinery



Closing the loop: Towards a self-sufficient biorefinery



Closing the loop: Towards a self-sufficient biorefinery



The diagram illustrates a lignocellulosic biorefinery process flow, starting from **Bioressourcen** (Bioresources) and leading to various products and fractions. The process includes **Extraction**, **Solid-liquid separation**, **Membrane separation**, **Solid treatment**, **Lignin precipitation and separation**, and **High value extract**. The fractions produced are **Cellulose fraction**, **Xylose fraction**, and **Lignin fraction**. The process is surrounded by concentric green circles representing different levels of assessment: **Experiments**, **Mass & Energy balances**, **LCA / Technology assessment**, and **Cost analysis**. The TU Wien logo is visible in the bottom right corner of the process flow area.



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Thank you for your attention!

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Questions



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