

# Valuables from residues

How innovations turn waste into bio-based products

This advances climate protection in a multitude of ways:

- Carbon storage in products and soils
- Storable energy sources and products
- Regional food production with modern fertilizers, and more

► Sustainability needs science



## Innovative Organisation

- Separation by type
- Short, climate-neutral routes
- Neighborhood solutions for citizens
- Efficiency through digitalization
- Synergies of supply and disposal



## Innovative technique

- Variable feedstocks and systems
- Mobile, decentral and central modules
- Adaptation to local requirements
- Material and energy utilization
- Versatile products from residues

# The path to a modern bioeconomy

– economically, ecologically and socially sustainable –

# What can the bioeconomy do?

Waste wood

Food waste

Landscaping waste

Agricultural waste

BIO

REFINERY

fabricates substantial products and energy

Specialty products

Mass products

Replacement products

Energy products

## Specialty products:

High-quality bio-based secondary raw materials such as fibers, oligosaccharide sugars and cellulose nano-crystals, e.g. for high-quality papers, emulsions and 3D printing, respectively.



## Mass products:

Conversion of residues that are not appropriate for higher-value applications to high-demand products, such as composts, compost extracts or pellets for multiple applications.



## Replacement products:

Secondary raw materials from waste as substitutes for biogenic primary or fossil resources in the manufacture of conventional products such as fertilizers, plastics or cardboard.



## Energy products:

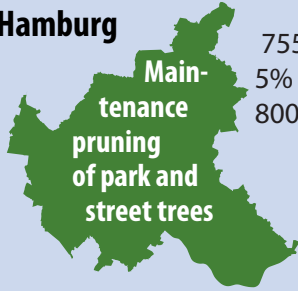
Conversion of residues that are not suitable for substantial applications to energy carriers and products such as biofuels, biomethane, electricity or heat.



# How does the bioeconomy work?

## Exemplary valorisation paths for residues

### Hamburg



755 km<sup>2</sup> of city area, with 5% public green space and 800,000 city trees

15,000 - 30,000 t prunings per year

### Current situation:

Only a part of the maintenance pruning remains in the region. This is composted, incinerated more or less efficiently, or disposed of in other ways.

## Possible biorefinery module for Hamburg

Tree pruning residues    Other woody waste

### Preparation

Shredding  
Screening  
Washing

### Main processes

Steam pressure treatment

### Refinement

Centrifugation  
Filtration

### Residue utilization

Anaerobic digestion  
Composting

Residues and products vary according to temporal and local occurrence and demand. Decentralized units become regionally networked valorization systems.

Fibres for packaging

Oligosaccharides for emulsifiers

Biogas for electricity and heat

Composts as soil improvers

# What does the bioeconomy need?

## Tasks for politicians and administration

- Document regional bioresources (bioresource and stakeholder cadastres)
- Separate waste at the origin and direct it regionally (organisation, infrastructures)
- Evaluate process combinations and cascades (ecological, economic, social)
- Create incentives for carbon sinks (plants, bio-based products, soils)

# FLEXIBI

FLEXIBI stands for „Small flexible biorefineries with flexible inputs“. Six partners from four EU countries are investigating process chains to use residues efficiently in terms of materials and energy recovery. These are developing tools to optimally match residues with processes and to evaluate the systems in terms of their economic, ecological and social sustainability.

## Other exemplary valorization paths for residues:

- Loire-Atlantique: Greenhouse residues and waste MDF to proteins, nano-cellulose, compost, bioenergy
- DePinte: Biowaste from private households to bio-energy, various composts, fertilizers

**Countries:** France, Germany, Belgium, Finland

## Project management:

Dr. Bernard Cathala | Prof. Jan Van Impe | Dr. Mark Irle | PD Dr. habil. Ina Körner | Prof. Dr. habil. Bodo Saake | Prof. Dr. Maija Tenkanen

## Scientists:

Aicha Ait-Sair | Christophe Belloncle | Estelle Bonnin | Satyajeetsheetal Bonsale | Viviane de Buck | Michaud Franck | Sebastian Hagel | Kamal Kansou | Satu Kirjoranta | Marc Lahaye | Phillipp Lüssenhop | Kirsi S. Mikkonen | Annalena Ritter | Mihaela I. Sbarciog | Steffen Walk

## Further information and contacts:

[www.bioresource-tools.net](http://www.bioresource-tools.net)  
[info@bioresource-tools.net](mailto:info@bioresource-tools.net)

**Brochure contributors:** EnergieNetz Hamburg eG | MünzbergDesign, Dessau | StillaDesign, Hamburg

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