Premiere of the Tech4Biowaste database

A dynamic database of relevant technologies of biowaste utilisation

This project receives funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101023200. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.

WEBINAR NOTICES

This session is being recorded; we will share the video on SM and on the project's website

Please, use the chat function to enter your questions

Please, keep your cameras and microphones switched off unless you're presenting

TECH4 BIOWASTE

Agenda

11:00 – 11:05 | **Welcome and introduction to Tech4Biowaste**
John Vos, BTG Biomass Technology Group BV

11:05 – 11:25 | **Tour through the Tech4Biowaste database**
Dr Lars Krause, nova-Institute

11:25 – 11:30 | **Benefits of joining the Tech4Biowaste database**
Stef Denayer, Bio Base Europe Pilot Plant vzw

11:30 – 11:45 | **Q&A**

Moderator: Freya Sautner, nova-Institute

Short introduction to the Tech4Biowaste project

Framework

Type of Action
Coordination & Support Action

Term
April 2021 – March 2023

Countries
3

BBI JU Contribution
€ 989,781

Call: BBI.2020.S2

Tech4Biowaste develops a database on biowaste valorisation technologies. It covers technology readiness levels 4 and higher, relevant feeds and products. The database will contain up-to-date information, will be user-friendly, well-maintained and accessible to everybody.

TECH4 BIOWASTE

btg biomass technology group

Bio Base Europe Pilot Plant

nova Institute

Aim

Technology

Providers

- Show your technology
- Find the right feedstock for your technology
- Find new business partners

Technology

Searchers

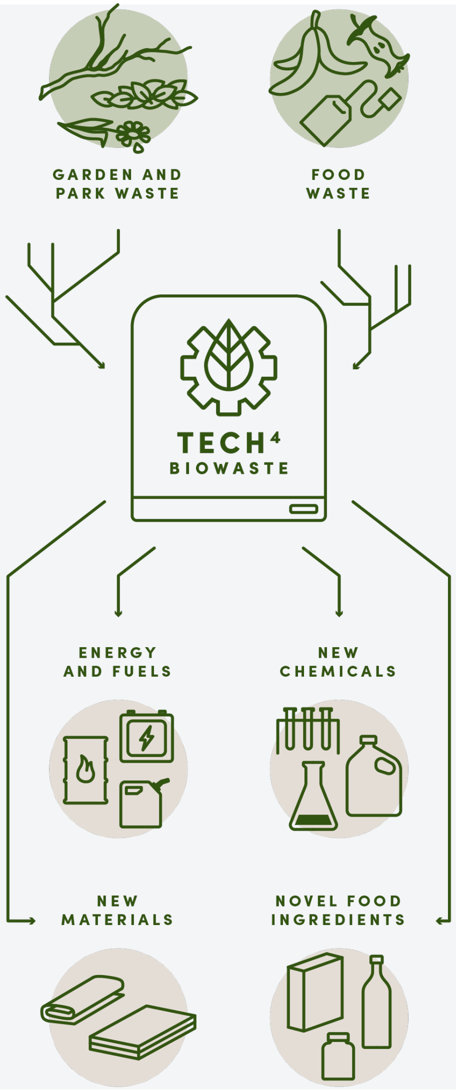
- Search for technologies and technology suppliers
- Find the right application for your feedstock
- Make new contacts

Key characteristics

Focus on Biowaste

- Available across EU in large volumes
- High on political & research agenda


© Picture: BBEPP



Key characteristics

Implemented with MediaWiki software

- Tailored for the **intended use as technology database**.
- Allows presentation & comparison of complex info in **encyclopaedic style**
- The contents of the database are **easily modifiable** for a wide range of users without the need for advanced programming skills.
- A **revision & monitoring mechanism** allows to control & restore content.
- The user-friendliness of the selected software ensures that the database can be supported by the community **beyond the time frame of T4B**.

MediaWiki

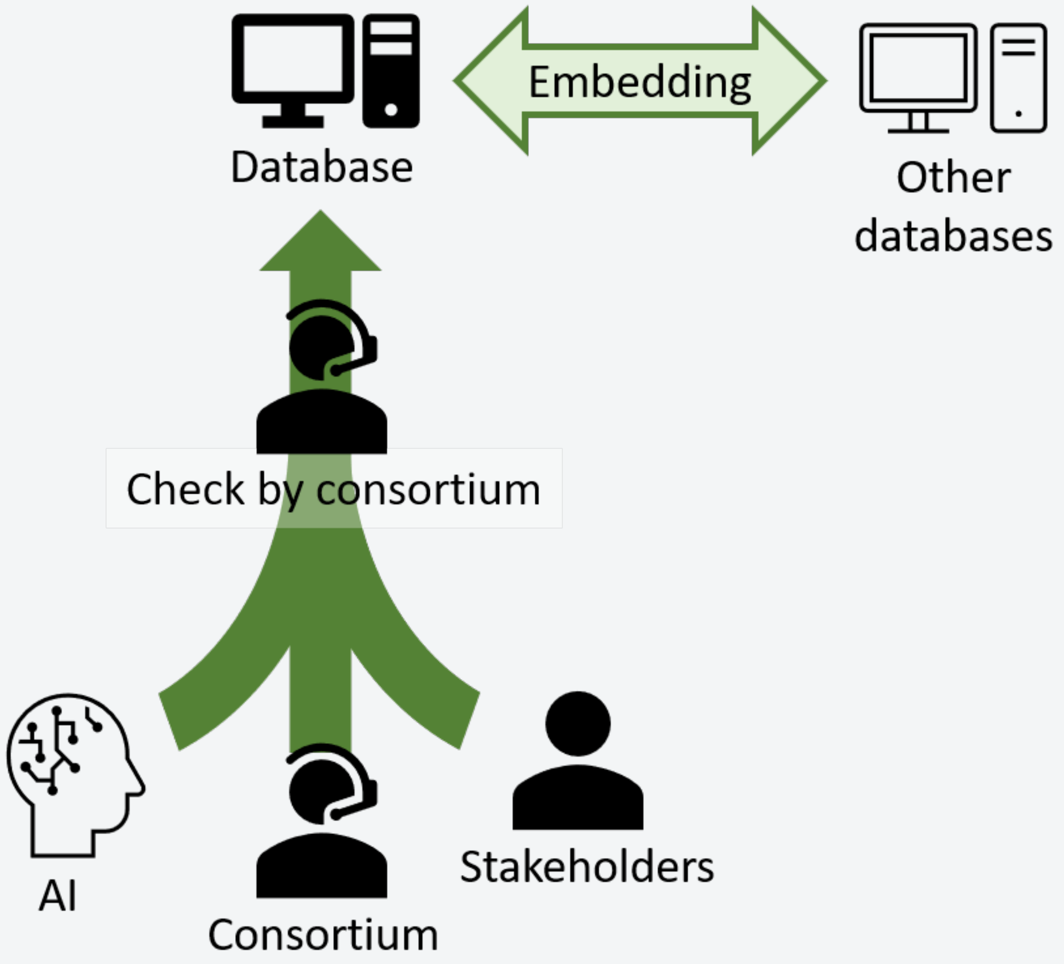
Key characteristics

Hybrid Model

To build, populate and update the database

Combining contributions from:

- Consortium partners
- External community of volunteers
- Automated scripts (“bots”)



Designed for long-term continuity

Pilots4U is the EU-wide network & database of open access multipurpose pilot and demo infrastructures for the European bio-economy

- Partnering with Pilots4U network and Renewable Carbon Community (RCC) portal
- Business plan supporting continuity and sustainability of project outcomes

The RCI is to support and speed up the transition from fossil carbon to renewable carbon for all organic chemicals and materials.

Tour through the Tech4Biowaste database

2022-03-21

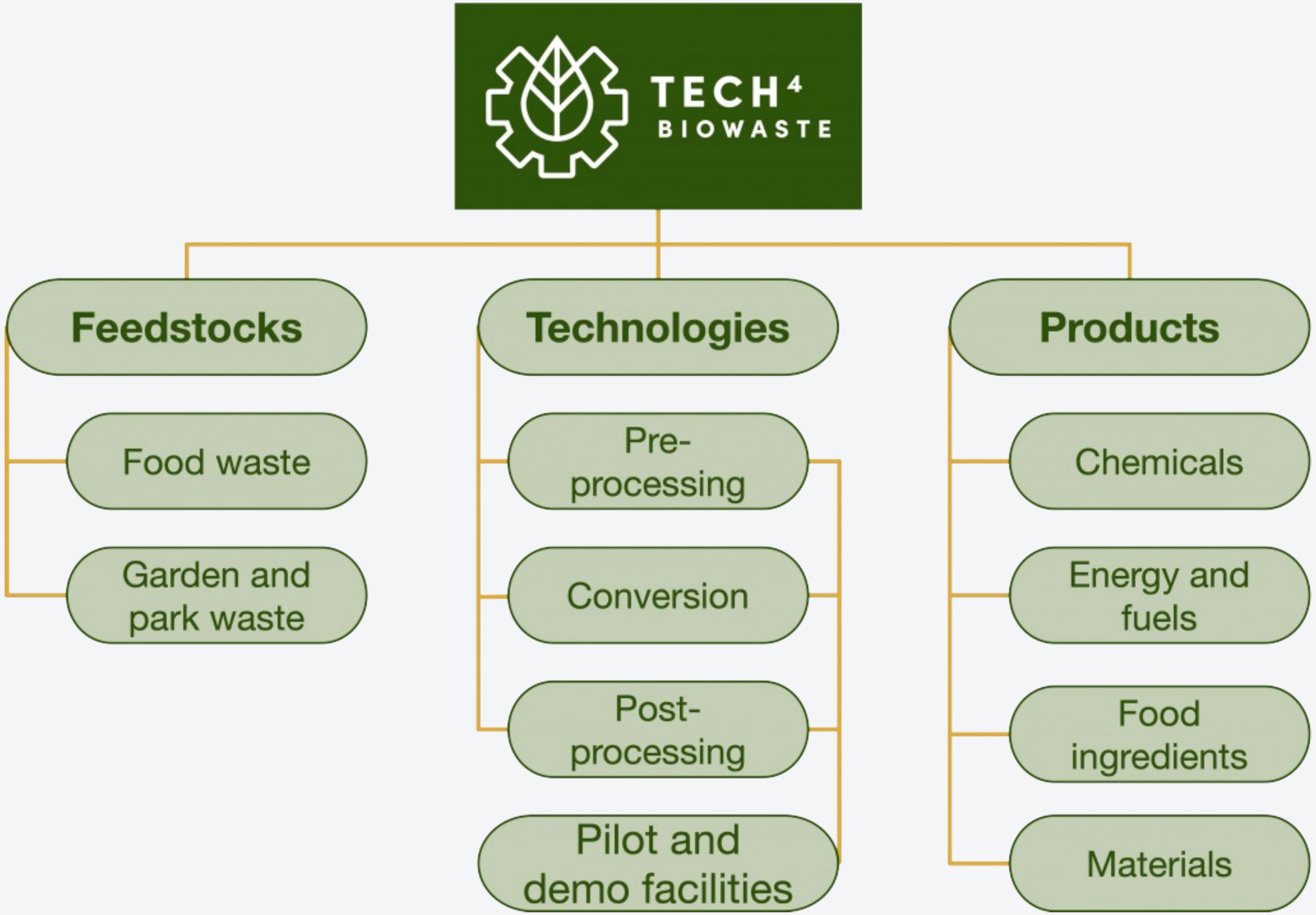
Dr. Lars Krause

Mail: lars.krause@nova-institut.de

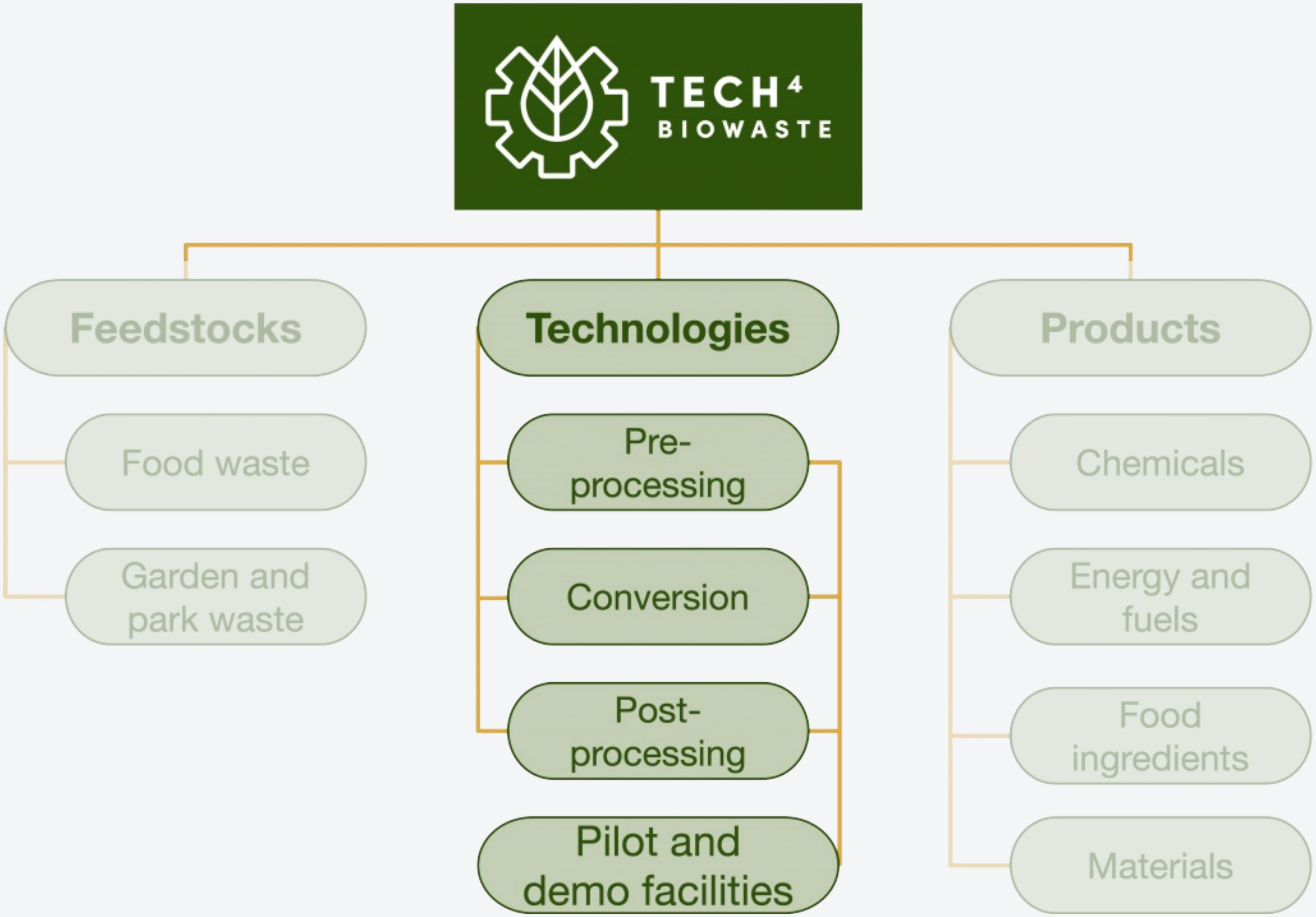
Tour through the Tech4Biowaste database

Article structure, technologies, and other content

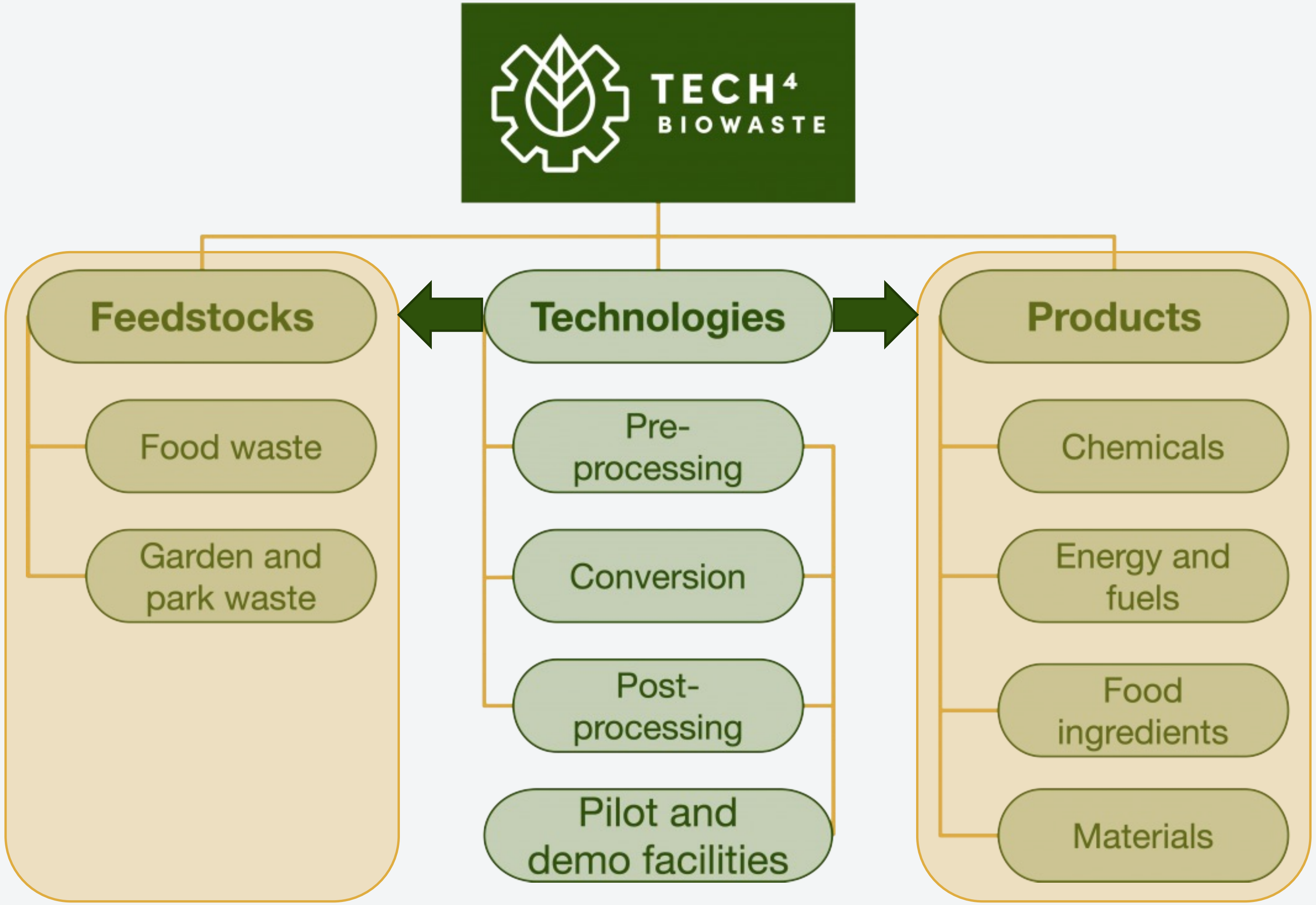
Tour through the Tech4Biowaste database



Tour through the Tech4Biowaste database



Tour through the Tech4Biowaste database



Database/article structure, technologies, and other content

43 technologies

Pre-processing

Pre-processing technologies are utilised in the pre-treatment of biowaste to obtain chemicals and/or materials which will then go into the conversion followed by an optional post-processing after which the final product is obtained. While some technologies are used exclusively for the purpose of pre-processing, others such as the separation processes and technologies can be utilised in both pre- and post-processing.

Contents [hide]

Conversion

Conversion (not to be confused with chemical conversion) covers either the direct (without pre-processing) or indirect (with pre-processing) valorisation of biowaste into a final product followed by an optional post-processing.

Contents [hide]

Post-processing

Post-processing technologies are utilised in the post-treatment or upgrading of chemicals and/or materials obtained from the conversion after which the final product is obtained. While some technologies are used exclusively for the purpose of post-processing, others such as the separation processes and technologies can be utilised in both pre-processing and post-processing.

Contents [hide]

Database/article structure, technologies, and other content

Each technology article begins with quickly accessible basic information:

- Short description
- Infobox
- Table of content

Pyrolysis

Pyrolysis (from greek *pyr*, "fire" and *lysis*, "loosing/unbind") is a conversion technology that utilises a thermochemical process to convert organic compounds in presence of heat and absence of oxygen into valuable products which can be solid, liquid or gaseous. The chemical transformations of substances are generally accompanied by the breaking of chemical bonds which leads to the conversion of more complex molecules into simpler molecules which may also combine with each other to build up larger molecules again. The products of pyrolysis are usually not the actual building blocks of the decomposed substance, but are structurally modified (e.g. by cyclization and aromatisation or rearrangement).

Technology	
Technology details	
Name:	Pyrolysis
Category:	Conversion (Thermochemical processes and technologies)
Feedstock:	Garden and park waste (wood, leaves)
Product:	Coal, pyrolysis oil, pyrolysis gas

Database/article structure, technologies, and other content

Feedstock [WYSIWYG edit | Wikitext edit]

Origin and composition [WYSIWYG edit | Wikitext edit]

Since all kind of biowaste contains hydrocarbonaceous material it can also be processed via pyrolysis. However, the composition of the feedstock has an impact on the pyrolysis process and therewith on the products which can be obtained. Usually wood and herbaceous feedstocks are processed which are composed differently[1] which qualifies garden and park waste as suitable feedstock.

Typical composition of typical pyrolysis feedstocks[1]

Feedstock:	Corn stover	Switchgrass	Wood
Proximate analysis wt [%]			
Moisture	8.0	9.8	42.0
Ash	6.9	8.1	2.3
Volatile matter	69.7	69.1	47.8
Fixed carbon	15.4	12.9	7.9
Elemental analysis [%]			
Carbon	49.7	50.7	51.5
Hydrogen	5.91	6.32	4.71
Oxygen	42.6	41.0	40.9
Nitrogen	0.97	0.83	1.06
Sulphur	0.11	0.21	0.12
Chlorine	0.28	0.22	0.02
Structural organics wt [%]			
Cellulose	36.3	44.8	38.3
Hemicellulose	23.5	35.3	33.4
Lignin	17.5	11.9	25.2

Contents [hide]

Database/article structure, technologies, and other content

Pre-treatment [WYSIWYG edit | Wikitext edit]

The pre-treatment of the feedstock has an impact on the pyrolysis process, its efficiency, and the yield of certain products. The following pre-treatments may be considered [2]:

- Sizing (e.g. chipping, grinding)
- Densification (e.g. pressure-densification)
- Steam explosion
- Drying (e.g. air drying, freeze-drying)
- Extraction (e.g. acid and alkali treatment for the removal of minerals)
- Wet torrefaction
- Ammonia fibre expansion
- Composting (e.g. Decomposing via fungi)

Contents [hide]

Database/article structure, technologies, and other content

Process and technologies [WYSIWYG edit | Wikitext edit]

The pyrolysis is an endothermal process requiring the input of energy in form of heat which can either be directly (direct pyrolysis) applied via hot gases or indirectly (indirect pyrolysis) via external heating of the reactor. Compared to gasification, the process takes place in an atmosphere without oxygen or at least under a limitation of oxygen.

In general, pyrolysis can be divided into different steps which include:

1. Evaporation and vapourisation of water and other volatile molecules which is induced at temperatures > 100 °C
2. Thermal excitation and dissociation of the molecules induced at temperatures between 100-600 °C, which also may involve the production of free radicals as intermediate stage
3. Reaction and recombination of the molecules, and triggering of chain reactions through free radicals

The pyrolysis process and the formation of products can be controlled to a certain extend via different temperature ranges and reaction times as well as by utilising reactive gases, liquids, catalysts, alternative forms of heat application (e.g. via microwaves or plasma), and a variety of reactor designs. Depending on the residence time and temperature as well as different technical reaction environments the pyrolysis can be categorised under diffferent terms as follows.

Categorisation according residence time and temperature [WYSIWYG edit | Wikitext edit]

- Fast pyrolysis
- Intermediate pyrolysis
- Slow pyrolysis (charring, torrefaction)

Categorisation according technical reaction environment [WYSIWYG edit | Wikitext edit]

Depending on these factors the pyrolysis technology can be divided into different categories as follows:

- Catalytic cracking
  - One-step process
  - Two-step process
- Hydrocracking
- Thermal cracking
- Thermal depolymerisation

Reactions [WYSIWYG edit | Wikitext edit]

A range of different reactions occur during the process such as dehydration, depolymerisation, isomerisation, aromatisation, decarboxylation, and charring[2].

Contents [hide]

Database/article structure, technologies, and other content

Product [WYSIWYG edit | Wikitext edit]

A range of solid, liquid, and gaseous products can be obtained from the pyrolysis process including char, pyrolysis oil, and pyrolysis gas. Depending on the feedstock origin and composition as well as the pre-treatment and process the yield as well as the chemical and physical properties of the products can vary.

Char [WYSIWYG edit | Wikitext edit]

Wood-based char

As mentioned the functional properties of char may vary which includes carbon content, functional groups, heating value, surface area, and pore-size distribution. The application possibilities are versatile, the char can be used as soil amendment for carbon sequestration, soil fertility improvement, and pollution remediation. Furthermore the char can be used for catalytic purposes, energy storage, or sorbent for pollutant removal from water or flue-gas.

Pyrolysis oil [WYSIWYG edit | Wikitext edit]

Produced pyrolysis oil is a multiphase emulsion composed of water and hundreds of organic molecules such as acids, alcohols, ketones, furans, phenols, ethers, esters, sugars, aldehydes, alkenes, nitrogen- and oxygen- containing molecules. A longer storage or exposure to higher temperature increases the viscosity due to possible chemical reactions of the compounds in the oil which leads to the formation of larger molecules[3]. The presence of oligomeric species with a molecular weight >5000 decreases the stability of the oil[2]. Furthermore, the formation of aerosols from volatile substances accelerates the aging process in which the water content and phase separation increases. The application as fuel in standard equipment for petroleum fuels (e.g. boilers, engines, turbines) may be limited due to poor volatility, high viscosity, coking, and corrosiveness of the oil[3]. To overcome these problems, the pyrolysis oil has to be upgraded in a post-treatment to be used as fuel and/or the equipment for the end-application has to be adapted.

Pyrolysis gas [WYSIWYG edit | Wikitext edit]

Syngas can be obtained from the pyrolysis gas which is composed of different gases such as carbon dioxide, carbon monoxide, hydrogen, methane, ethane, ethylene, propane, suphur oxides, nitrogen oxides, and ammonia[2]. The different gases can be fractionated from each other in the post-treatment to utilise them for different applications such as the production of chemicals, cosmetics, food, polymers or the utilisation as fuel or technical gas.

Contents [hide]

Database/article structure, technologies, and other content

Syngas can be obtained from the pyrolysis gas which is composed of different gases such as carbon dioxide, carbon monoxide, hydrogen, methane, ethane, ethylene, propane, suphur oxides, nitrogen oxides, and ammonia[2]. The different gases can be fractionated from each other in the post-treatment to utilise them for different applications such as the production of chemicals, cosmetics, food, polymers or the utilisation as fuel or technical gas.

Post-treatment [WYSIWYG edit | Wikitext edit]

- Fischer-Tropsch-Synthesis

Contents [hide]

Tour through the Tech4Biowaste database

Database/article structure, technologies, and other content

Technology providers [WYSIWYG edit | Wikitext edit]

Technology comparison [Collapse]

Company name	Country	City	Technology category	Technology name	TRL	Capacity [kg/h]	Catalyst	Reactor	Temperature [°C]	Feedstock: Food waste	Feedstock: Garden & park waste	Product: Char	Product: Oil	Product: Syngas
BioBTX	The Netherlands	Groningen	Catalytic Pyrolysis, two-step	Integrated Cascading Catalytic Pyrolysis (ICCP) technology	5-6	10				•	•	•	•	•
BTG Bioliquids	The Netherlands	Hengelo	Fast Pyrolysis	BTG fast pyrolysis technology	8-9	5,000				•	•	•	•	•

Contents [hide]

TECH4 BIOWASTE

btg biomass technology group

Bio Base Europe Pilot Plant

nova Institute

Tour through the Tech4Biowaste database

Database/article structure, technologies, and other content

BioBTX [WYSIWYG edit | Wikitext edit]

Pyrolysis provider

General information			
Company:	Bio-BTX B.V.		
Country:	The Netherlands		
Contact:			
Webpage:	https://biobtx.com/		
Technology and process details			
Technology name:	Integrated Cascading Catalytic Pyrolysis (ICCP) technology	Technology category:	Conversion (Thermochemical processes and technologies)
TRL:	5-6	Capacity:	10 kg·h^{-1}
Atmosphere:	Inert	Catalyst:	Zeolite
Heating:	Fluidised sand bed	Pressure:	1-4 bar
Reactor:	Fluidised sand bed, fixed bed	Temperature:	450-650 °C
		Other:	Unknown
Feedstock and product details			
Feedstock:	Biomass (liquid, solid), wood pulp lignin residues, used cooking oil	Product:	Benzene, toluene, xylene, aromatics, light gases

BioBTX was founded in 2012 by KNN and Syncom in collaboration with the university of Groningen, Netherlands. The company is a technology provider developing chemical recycling technologies for different feedstocks including non-food bio- and plastics waste. In 2018 a pilot plant with the capability to process biomass and plastic waste was set up at the Zernike Advanced Processing (ZAP) Facility. The company is now focused on setting up their first commercial plant with a capacity of 20,000 to 30,000 tonnes. The investing phase B was recently completed, with the last investment phase in 2019 the financial requirements are fulfilled to complete the commercialisation activities to build the plant which is expected for 2023.

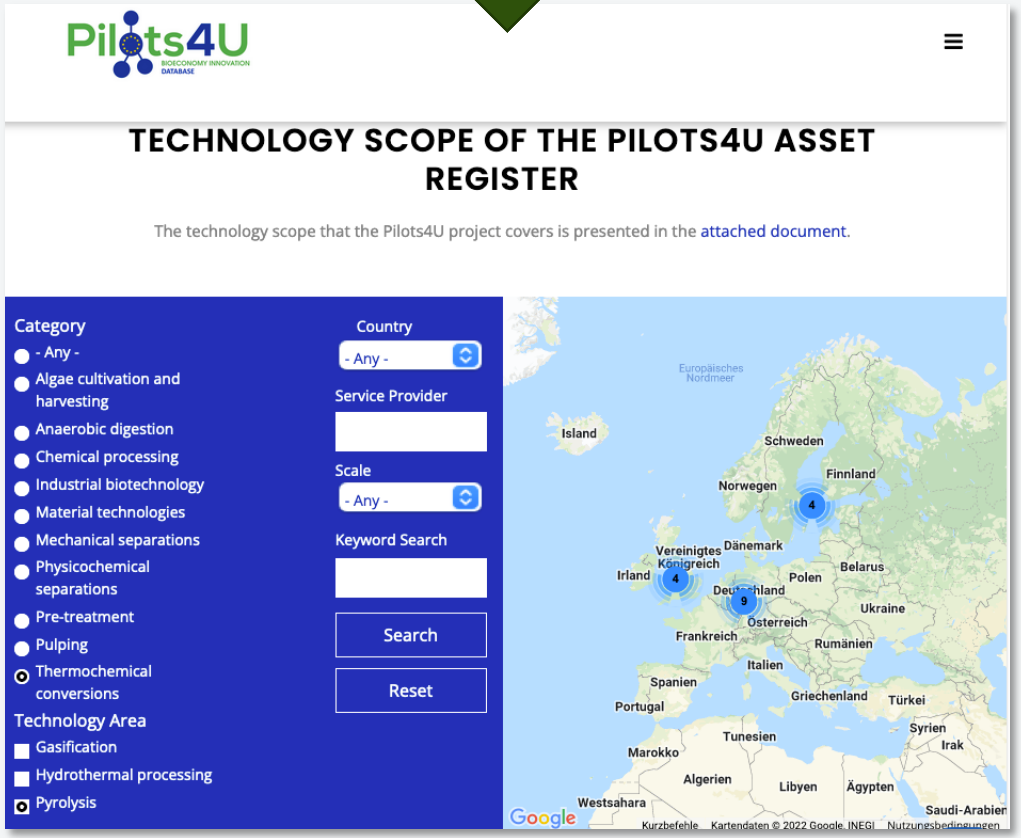
The technology is based on an Integrated Cascading Catalytic Pyrolysis (ICCP) process, being able to produce aromatics including benzene, toluene, and xylene (BTX) as well as light olefins from low grade biomass and plastics waste. This technology utilises catalytic cracking in a two-step process at temperatures between 450- 850 °C. In the first step the feedstock material is vaporised via thermal cracking. The pyrolysis vapours are then directly

Contents [hide]

Database/article structure, technologies, and other content

Open access pilot and demo facility providers [WYSIWYG edit | Wikitext edit]

Pilots4U Database



Contents [hide]

Database/article structure, technologies, and other content

Patents [WYSIWYG edit | Wikitext edit]

Currently no patents have been identified.

References [WYSIWYG edit | Wikitext edit]

Al Arni, S. 2018: Comparison of slow and fast pyrolysis for converting biomass into fuel. Renewable Energy, Vol. 124 197-201. doi:https://doi.org/10.1016/j.renene.2017.04.060

Czajczyńska, D., Anguilano, L., Ghazal, H., Krzyżyńska, R., Reynolds, A. J., Spencer, N. and Jouhara, H. 2017: Potential of pyrolysis processes in the waste management sector. Thermal Science and Engineering Progress, Vol. 3 171-197. doi:https://doi.org/10.1016/j.tsep.2017.06.003

Speight, J. 2019: Handbook of Industrial Hydrocarbon Processes. Gulf Professional Publishing, Oxford, United Kingdom.

Tan, H., Lee, C. T., Ong, P. Y., Wong, K. Y., Bong, C. P. C., Li, C. and Gao, Y. 2021: A Review On The Comparison Between Slow Pyrolysis And Fast Pyrolysis On The Quality Of Lignocellulosic And Lignin-Based Biochar. IOP Conference Series: Materials Science and Engineering, Vol. 1051 doi:10.1088/1757-899X/1051/1/012075

Waheed, Q. M. K., Nahil, M. A. and Williams, P. T. 2013: Pyrolysis of waste biomass: investigation of fast pyrolysis and slow pyrolysis process conditions on product yield and gas composition. Journal of the Energy Institute, Vol. 86 (4), 233-241. doi:10.1179/1743967113Z.00000000067

Zaman, C. Z., Pal, K., Yehye, W. A., Sagadevan, S., Shah, S. T., Adebisi, G. A., Marliana, E., Rafique, R. F. and Johan, R. B. 2017: Pyrolysis: A Sustainable Way to Generate Energy from Waste. IntechOpen

1. ↑ [a] [b] Carpenter, D., Westover, T. L., Czernik, S. and Jablonski, W., 2014: Biomass feedstocks for renewable fuel production: a review of the impacts of feedstock and pretreatment on the yield and product distribution of fast pyrolysis bio-oils and vapors. Green Chemistry, Vol. 16, (2), 384-406. doi: https://doi.org/10.1039/C3GC41631C
2. ↑ [a] [b] [c] [d] Hu, X. and Gholizadeh, M., 2019: Biomass pyrolysis: A review of the process development and challenges from initial researches up to the commercialisation stage. Journal of Energy Chemistry, Vol. 39, 109-143. doi: https://doi.org/doi:https://doi.org/10.1016/j.jechem.2019.01.024
3. ↑ [a] [b] Czernik, S. and Bridgwater, 2004: Overview of Applications of Biomass Fast Pyrolysis Oil. Energy & Fuels, Vol. 18, (2), 590-598. doi: https://doi.org/10.1021/ef034067u

Categories: Conversion | Technologies

Contents [hide]

How-to-Wiki & EDIT-A-THON series

- If you want to contribute: Practical training will be offered for first-time Wiki users
  - Introduction of basic functions
  - Q&A on individual topics
  - Jointly working on the Wiki (Articles/Profiles/etc.)

- Biweekly on Mondays 14:00-17:00

- Next meeting this afternoon

- Account required, please write an e-mail to

  lars.Krause@nova-institut.de (only today)

  info@tech4biowaste.eu (regular address)

- You will receive the login-information (+preliminary password) for the Wiki as well as the invitation to the event

Benefits of joining the Tech4Biowaste database

You become findable for free

You become easy findable Europe wide

You become easy findable for feedstock owners

You become easy findable for product owners

You become easy findable for colleague technology owners

You become easy findable via other platforms

Pilots4U
BIOECONOMY INNOVATION DATABASE

Online coaching sessions

Edit-a-thons

We provide coaching on how to add your biowaste technology to the database.

The first coaching sessions will take place on:

- Monday 21 March – 14:00 CET **(today!)**
- Monday 4 April – 14:00 CEST
- Tuesday 19 April – 14:00 CEST

To register: send email to info@tech4biowaste.eu

Q & A Session

Keep in Touch

Ways to connect

Email:

info@tech4biowaste.eu

Web:

www.tech4biowaste.eu

Tech4Biowaste group in the Renewable Carbon Community:

renewable-carbon-community.com/tech4biowaste-registration

© Picture: BBEPP

Coordinator:

John Vos (BTG)

Stakeholder Relations Manager:

Stef Denayer (BBEPP)

Communication & Dissemination:

Freya Sautner (nova)

Thank You!

Tech4Biowaste Consortium

btg biomass technology group

Bio Base Europe Pilot Plant

nova Institute for Ecology and Innovation

Partner Projects

Pilots4U BIOECONOMY INNOVATION

RENEWABLE CARBON INITIATIVE