Call for partners –
Circular Water & Biobased Products
Project ideas to start in 2025

Join a Public-Private-Partnership consortium with Wageningen Food & Biobased Research

Each year, Wageningen Food and Biobased Research (WFBR) partners with Industry, research institutes, NGOs, and other stakeholders in Topsector Agri & Food consortium projects. In this document, the WFBR programmes in the biobased domain present their Public-Private-Partnership project ideas to start in 2025.

The ideas have been organised by programme:

- Renewable Plastics
- Safe and Circular Biobased Products
- Nature Based Materials
- Circular Water Technologies

The project ideas are still in their early stages, which has the advantage that they can be adjusted to the research needs of partners who would like to join the consortium. If you would like more information or if you want to express your interest in joining any of the project consortia, please contact the relevant Programme Manager before the end of May 2024.

The submission deadline for the project proposals to the funding agency is 1 September 2024. The main general terms, conditions, and timeline for consortium projects can be found at the end of this document.

Wageningen Food and Biobased Research
Together with our clients and partners, WFBR creates economically viable and sustainable solutions to contribute to supplying a rapidly growing world population with healthy, delicious, sustainably produced food and high-quality materials, chemicals, and fuels made from biomass. As a contract research organization, WFBR conducts applied and pre-competitive research for NGOs, governments and industrial partners. This work is conducted within bilateral projects and scientific grants, as well as Public-Private-Partnerships such as Topsector Agri & Food consortia.

WFBR not only has Public-Private-Partnerships for Circular Water & Biobased Products, but also for Postharvest Quality, Vision + Robotics, Sustainable Nutritious Foods, Food Loss & Waste Prevention, Proteins for Life and Nutrition for Optimal Health. A full overview of all WFBR project ideas are available at www.wur.eu/call-for-partners.

Safe and Circular Biobased Products

The programme "Safe and Circular Biobased Products" is focused helping industry with safe and circular biobased solutions in order to develop a more sustainable, safe and circular economy. Please find below the project ideas for 2025.

Programme manager: Jacco van Haveren (jacco.vanhaveren@wur.nl)

Project 1

Sugar based formaldehyde and phenol free resins

Phenol-formaldehyde (PF) and other formaldehyde resin systems are important thermoset binders used in a wide range of applications. However, both phenol and formaldehyde are toxic substances of (very high) concern. Another issue is the non-biodegradability of the resins, thereby contributing to the release of (micro)plastics in the environment. WFBR offers to assist industry in developing safe alternative chemistries for PF resins with high binding strength, mechanical performance, low viscosity in aqueous formulations, and improved biodegradability. The project will pursue combinations of relatively low molecular weight sugars and alternatives to formaldehyde to design a system that satisfies the required properties.

Project 2

Microbial oil production

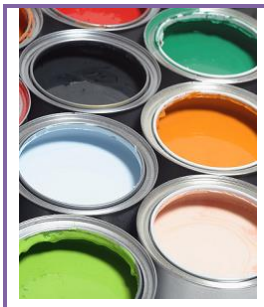
There is an increasing attention to microbial oils as sustainable alternative for palm oil. However, the yields obtained with microorganisms cannot yet compete with palm oil production. In this project, we want to collaborate with industrial partners to obtain specific microbial oils or fatty acid derived products for selected applications, which are compatible in the market. We propose several possibilities to receive this goal: the use of cheap side stream as feedstock, the use of engineered strains for effective side stream conversion, strain engineering to add value to the oil (i.e. production of omega-3-fatty acids or medium chain fatty acids), or the identification of high value added applications such as personal care. The approaches will be combined with techno-economic analyses.

Project 3

Hydroxy fatty acids and estolides valorisation

Hydroxy fatty acids and their derivatives such as estolides, have a huge application potential in products like home and personal care products (as emollients, cleansing agents, texture enhancers), detergents, cosmetics, lubricants (as a base oil), resins and coatings and polymer applications like polyurethane foams and pressure sensitive adhesives. Hydroxy fatty acids may be obtained from natural sources, e.g. castor oil. However, castor oil production is geographically limited and risks exposure of workers to the toxin ricin.

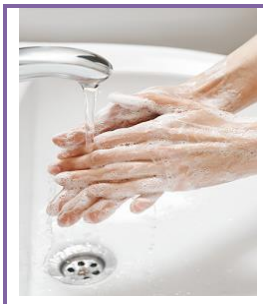
Chemical methods to derive hydroxy fatty acids from vegetable oils or fatty acids yield poorly defined structures or require elevated pressure, high temperatures and expensive catalysts. We will focus on an enzymatic approach that offers a favourable route in terms of Green Chemistry and results in well-defined product structures.



Project 4

Lignocellulosic side stream sugars to value added products

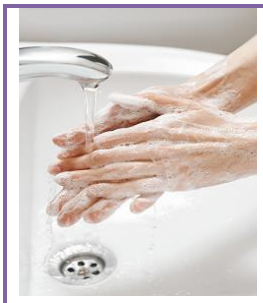
Solvolysis of lignocellulosic residues is a powerful tool to convert the lignin rich fraction into components suitable to be used as marine fuel or as precursors to chemicals and materials. Valorisation of the residual (hemi)cellulosic fraction will add to the overall economic viability of the solvolysis process. The aim of this project is to valorise the carbohydrate based side products resulting from these solvolysis reactions, such as alkyl levulinates and glucosides/xylosides. Applications of these side streams in home and personal care products, paints, coatings and composite materials will be pursued.



Project 5

Circular Polysaccharide modification by Advanced Tethering Agents (CIPOLATA)

Home and Personal Care (HPC) products need to become readily biodegradable in the near future. The use of renewable feedstocks, such as polysaccharides, offers many advantages for developing such products. However, in many cases the performance and storage stability requirements of these products are conflicting with the biodegradability at End-of-Life requirements. This project aims to develop new types of biobased functional linkers for the modification of polysaccharides to HPC products. The proposed linker technology will allow for flexibility in modification, thus enabling to tune the material properties to specific requirements, while at the same time having a molecular structure that ensures biodegradability.

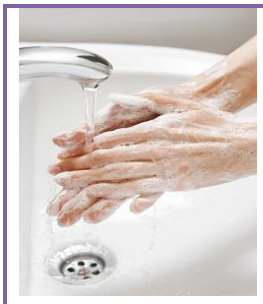


Project 6

bioCHAMP (biodegradable and circular hybrid aqueous multifunctional polymers)

Ingredients for Home Care (HC) products such as laundry detergents and dishwasher tablets need to become readily biodegradable in the near future. Many of these products contain ingredients such as polyacrylates and polyamines, that are very effective in the cleaning process but are not (sufficiently) biodegradable. The objective of this project is to develop new, bio-renewable, water borne multi-functional polymers for HC products that meet both performance and biodegradability requirements.

The bioCHAMP concept is based on combining water soluble and biodegradable biobased polymers with reversibly linked functional groups that will allow for flexibility in design and hence in tuning the specific properties.

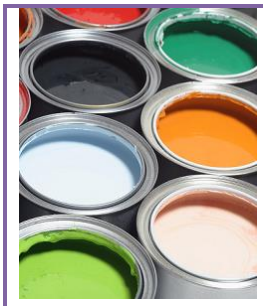


Project 7

Safe & Circular Carbohydrate-based Emulsifiers and SurfactantS (SCCESS)

Surface active substances (surfactants, soaps, emulsifiers) are important components used in a wide variety of applications and processes, including home and personal care products, agrochemicals, fibre spinning or textile manufacturing.

Many of the current surfactants are still predominantly based on fossil feedstocks, while others have issues regarding biodegradability or the use of undesired chemicals. Hence, there is a growing need for a wider variety of biobased and biodegradable anionic, cationic and non-ionic surfactants. This project will combine the use of agro residue derived carbohydrates, with novel reversible modification technologies to develop new, safe biodegradable surfactants. By employing state of the art computational chemistry and modelling methods, as well as developing machine learning (ML) methods, a broad variety of potential candidates will be screened, funnelled and selected for synthesis, application testing, as well as toxicity and biodegradation testing.



Project 8

REPLICATE: Renewable altErnatives to Bis-Phenol-A in producing resin and pLastIC mAterials wiThout compromising the key propertiEs

Bis-phenol-A (BPA) is extensively used in the production of polymeric materials for numerous applications including food and liquid containers, metal can inner linings, personal care products, packaging, sports and medical goods. Due to its endocrine disrupting effect, the European Chemicals Agency (ECHA) and the European Food Safety Authority (EFSA) are evaluating various measures to reduce the use and exposure levels of BPA, primarily in human and food contact materials. Building on the WFBR track record to develop rigid biobased building blocks and high-performance biobased polymers, our aim is to develop platform chemicals and polymers suitable to replace bis-phenol-A derived products in important application areas.

Project 9

Optimising recycling processes to minimise PFAS contamination

The main food safety concern for both paper and plastic food packaging relates to the migration of small molecules from the packaging into the food. These concerns are relevant to known endocrine disruptors such as phthalate plasticisers or bis-phenol A. These concerns are also relevant to PFAS (per-and poly fluoroalkyl substances). PFAS are a wide class of many different components. They are being used in a multitude of applications including food packaging to induce properties like water repellence or grease repellence. PFAS are persistent molecules that accumulate in the environment and are linked to the occurrence of toxicological effects like immune toxicity, neurotoxicity, tumour induction and endocrine disruption effects. The need for a more circular economy and hence the need for a higher percentage of recycled food packaging, makes it of imminent importance to be able to monitor and steer the presence of PFAS during food packaging recycling processes. The project intends to monitor the occurrence of PFAS in relation with food packaging and the effect of different recycling technologies on residual levels of PFAS in recycled food packaging.

Project 10

Valorisation of di- and tetracarboxylates formed via cathodic hydrocoupling

To reduce GHG emissions several transitions are required including electrification, utilizing renewable electrical energy, and the use renewable feedstocks. Unsaturated biobased carboxylates are an interesting source for electro-organic synthesis to yield hydrodimers, di- and tetracarboxylates. The so-called cathodic hydrocoupling reaction (Baizer process) is an established industrial process operating already at several hundred kton per annum scale in the production of adiponitirle. The advantage is the formation of unique and relatively untapped source of di- and tetracarboxylates and/or reduction of synthesis steps, where the challenge lies in the optimization of this electro-organic synthesis approach to obtain satisfactory yields. This project will build on previous work at WFBR, in which a proof-of-principle was established. The produced hydrocoupling product will be used as building block in for example biobased plastics, coatings, adhesives, sealants, elastomers, complexing agents, soil release agent, finishing agent and fragrance.

Circular Water Technologies

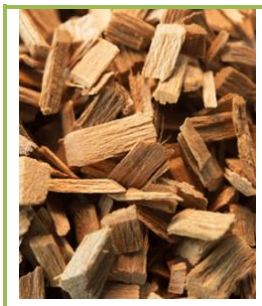
The WFBR programme on 'Circular Water Technologies' is focused on new water treatment solutions that are affordable and efficient. WFBR is developing technological onsite solutions for water purification, nutrient recovery and microbiological safe water, as well as by developing water treatment products that are biobased, biodegradable and safe. Please find below the project ideas for 2025.

Programme manager: Irma Steemers-Rijkse (irma.steemers-rijkse@wur.nl)

Project 11

A look into PFAS occurrence and removal

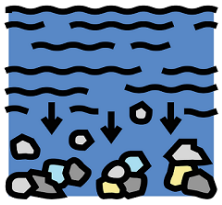
Treated wastewater is increasingly recognized as a potential resource, e.g. for irrigation in agriculture. However, the occurrence of PFAS (Per- and Polyfluoroalkyl Substances) and other micropollutants in wastewater treatment plant (WWTP) effluents and other residual streams presents a significant obstacle.



Project 12

Application and separation of wood vinegar - First the sour then the sweet

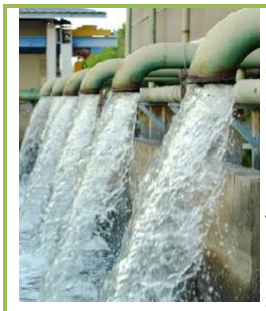
Pyrolysis can be used to utilize and valorise lignocellulosic biomass for example residue streams from agriculture and forestry. The primary product of rapid pyrolysis is pyrolysis oil. The by-product from the water removal process is the aqueous condensate that contains a lot of oxygenates such as acetic acid, formic acids, alcohols and phenolics, called wood vinegar. A good application for this stream has not been found yet, while it is important for the economy and circularity of the process.



Project 13

Biobased cationic flocculants

Water soluble synthetic polymers (WSPs) are growing environmental concern as these accumulate in nature due to poor biodegradability. Cationic synthetic polymers are a special type of WSP and largely used in wastewater treatment. The replacement of these polymers via biobased alternative demands a novel approach in modification.



Project 14

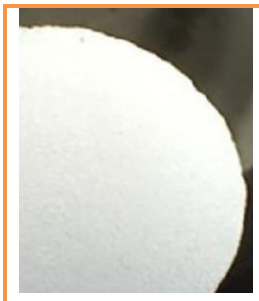
Selective Recovery of Valuable Compounds from Aqueous Streams

In a time when sustainability and efficient resource management have become essential, Wageningen Food & Biobased Research (WFBR) seeks to collaborate with industry stakeholders to innovate and implement processes for recovering valuable materials from residual aqueous streams. This initiative aims not only to reduce environmental footprints but also to generate economic advantages, shifting the focus from waste management to resource recovery to boost sustainability and operational efficiency.

Renewable Plastics

The WFBR programme 'Renewable Plastics' is working on the development of plastics from renewable raw materials, which are easy to recycle and do not accumulate in the environment. Please find below the project ideas for 2025.

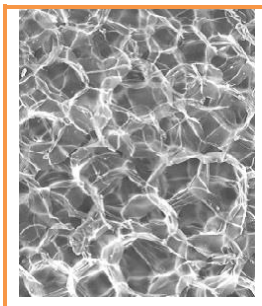
Programme manager: Karin Molenveld (karin.molenveld@wur.nl)



Project 15

DuraFoam: foams for durable applications using biobased polyesters

Foaming of (plastic) materials is a proven method to reduce the cost and weight of these materials and simultaneously add functionalities like insulation properties and cushioning. In this project we want to expand the application range of known biobased polyesters like PLA and upcoming biobased polyesters like PBS and PEF in extrusion foaming processes and make them suitable for durable applications such as construction or automotive.



Project 16

TempFoam: Biodegradable foams from waste and side streams

Most polymeric foams are made from fossil-based polymers that will persist when they end up in the environment. In most fossil-based foams on the market, chemical blowing agents are used contributing to global warming. It is known that natural polymers like starch can be foamed using water as a blowing agent. Furthermore, biobased micro- and nano-additives could also contribute to improving foam properties.

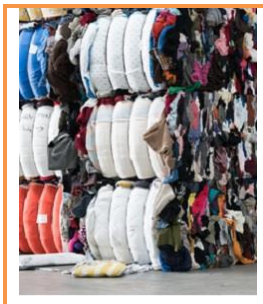
This project aims to develop biodegradable foams based on natural polymers like starches and other polysaccharides and eventually proteins retrieved from waste and side streams.

Specific focus will be on extrusion foaming and applications where biodegradability is an advantage (e.g. agriculture, packaging).

Project 17

Bottlebrush PLA co-polyesters for improved properties

Changing the molecular architecture (like branching) of polymers is an effective tool to influence the processing behaviour of these materials and to extend the application opportunities. By adapting the polymers architecture, the melt flow, melt strength, thermal properties and barrier properties can be improved. This project specifically focusses on enhancing the properties of PLA for packaging applications. The behaviour of new branched copolyesters will be studied on a small pilot scale that helps to demonstrate industrial relevance in thin-walled IM products, foams and film applications.



Project 18

Circular workwear without persistence of microfibers

The clothing industry extensively uses mixed and blended polyesters which at their end-of-life are difficult to be recycled into new clothes. Furthermore, during use and washing, the polyesters release millions of microfibers. Since these microfibers are not biodegradable, they accumulate in nature, polluting the soil, various water streams and the marine environment. In this project, we want to develop new biobased and biodegradable alternatives of conventional polyester fibers for workwear clothing in healthcare and service industry (e.g. uniforms for supermarket employees, delivery persons, healthcare workers, etc). These new polyester fibers will be designed and tested for optimal performance during use, recycling, washing and persistence in the natural environment. In this way a truly circular value chain for workwear could be realized without the accumulation of microfibers.

Project 19

The environmental fate of biodegradable plastics and their effect on the microplastic problem?

The societal acceptance of biodegradable products is notably affected by growing concerns on the amounts of microplastics found in the environment, their accumulation and their impact on ecosystems or human health. Biodegradable plastics are typically designed to fragment during use or at end-of-life, to be subsequently further metabolized and taken up in the biological carbon cycle. But what happens to these plastic products when they are released into the environment, disintegrated into smaller particles, and we can no longer see them? This project will develop methods that provide insight into the environmental fate of disintegrated biodegradable plastics and whether they potentially contribute to the microplastic problem.

Project 20

Edible Packaging and controlling moisture in foods

Edible packaging has extensive opportunities to enable the further development of sustainable and safe food chains, reducing food losses and reducing packaging requirements. However, further improvements are needed such as controlling moisture in foods. Especially coatings and films need excellent barrier properties towards water as well as to avoid dehydration.

Project 21

Solid state modification as a tool to develop new biobased plastics with unique properties

Via solid state modification, it is possible to develop new (biobased) plastics that are based on existing (semi-crystalline) biobased polymers and/or biobased building blocks. By this method it is possible to introduce a blocky structure while retaining crystallinity of the polymer. It can be used to improve properties of existing polymers or to introduce new functionalities that cannot be obtained by (co-)polymerization of existing building blocks. Examples of materials that could be prepared via solid state modification are water repellent materials with low water vapour barriers (textiles), elastic (TPE like) materials and the introduction of building blocks based on vegetable oils into polyesters to increase toughness.

Project 22

From biowaste to VFA to monomers

Industry has a growing interest to produce biobased plastics from organic residues and not from raw materials that are important food sources. A well-known alternative is the production of fermentable sugars from lignocellulosic materials and subsequent use of the sugars to produce the plastic monomers. However, these production processes are complex and expensive. The alternative studied in our proposal is to produce volatile fatty acids from organic wastes (already well proven) and reach sufficiently high concentration, so the VFAs can be used as fermentation substrate to produce various plastic monomers, such as succinic acid, butanediols and malonic acid.

Nature Based Materials

This WFBR programme 'Nature Based Materials' is working on the development of innovative technologies and value chains to source and valorize all the components in biomass as feedstock for renewable materials. Please find below the project ideas for 2025.

Programme manager: Edwin Hamoen (edwin.hamoen@wur.nl)

Project 23

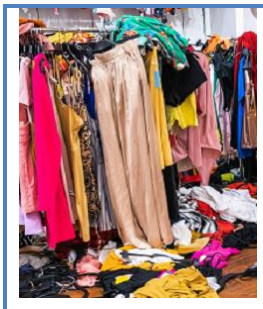
SidePro Protein transition – side stream valorization

The demand for non-animal-based foods, and especially for plant-based proteins, is booming. After protein extraction side streams such as starch and fibre are remaining and not fully valorised. Circular production systems for food demand upcycling of industrial side streams. Innovations on side stream valorisation will accelerate a sustainable protein transition towards plant-based protein sources.

Project 24

BOOST- Biostimulants from side streams

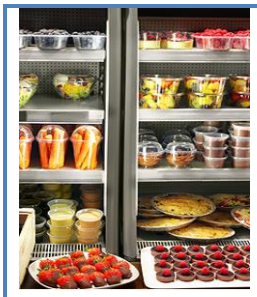
Biostimulant activity is claimed for several biomass extracts, but these are often of variable composition and their mode of action is often unknown. Well knows sources for biostimulant production are side streams from seaweeds, microalgae and fractions from processes such as composting and wastewater treatment. Testing the effectiveness of biostimulants is an expensive and time-consuming endeavor, usually involving plant growth trials. This also impedes monitoring biostimulant activity during processing of the input stream and after making process adjustments. This project should lead to robust production of biostimulants of proven quality from side streams.



Project 25

Framework Environmental Impact Textiles

The production of textiles involves high environmental impacts. Therefore, many stakeholders in the sector are addressing sustainability (e.g. Higg Index tools) and increasing attention for end-of-life. Focus, however, is mainly on individual businesses and within (part of) the industry sector only. Missing so far is: Taking the entire life of textile products into account, as well as quantitatively communicating environmental impact to consumers. A framework for quantification of the environmental impact of apparel/textiles over their entire service life up to final disposal will allow to optimise sustainability of the textiles value chains and is required to accelerate large scale implementation of sustainable textiles. Partners all along the value chain are invited to join the development of such framework.



Project 26

Sheetake - Fungal sheets from mushroom sidestreams

Explorative research highlighted that transparent, plastic-like sheets with high quality attributes can be produced from side-streams of edible mushroom production. The goal of the Sheetake project is to develop fully biobased, biodegradable fungal-based packaging materials for food and home and personal care applications to replace fossil-based analogues.

Project 27

Production and application of oleosin emulsifiers from rapeseed

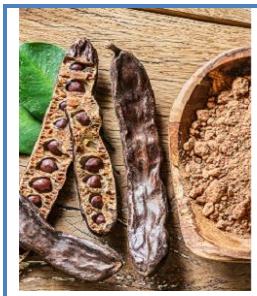
Oil is used as an ingredient in food products as an emulsion or powder in some cases. This powder is generally produced by making an oil-in-water emulsion and subsequent drying. The emulsion is stabilized by addition the addition of carbohydrates such as pectin, maltodextrin, gums or chitosan and proteins such as pea protein or whey protein. A specific drying process is used to dry the emulsion and make a powder. Spray drying is used on large scale to make oil powders that can be applied in for example infant nutrition.

The oil that is incapsulated is in many cases sensitive for oxygen and water, such as EPA or DHA. The coating therefore needs to have barrier properties to avoid degradation of the oil during storage. Storage of oil powders can be several months, therefore the barrier properties of the material that is used to stabilize the droplets needs to block water and oxygen for a long period.

Project 28

PRIMA: Protein FibRils for BIobased Materials

The need for more sustainable plastics is urgent. Since decades, research has been devoted to produce biomaterials and bioplastics from different types of biomaterials, such as starch and poly lactic acid. In addition to these materials certain protein containing biomass, that does conflict with the food supply, can be used as starting materials to create a new type of bioplastic, such as protein fibrils. Six years of research was devoted on the production of proteins fibrils. Some applications including packaging materials were initially already investigated.



Project 29

CARVES: Carob Valorisation for multiple applications

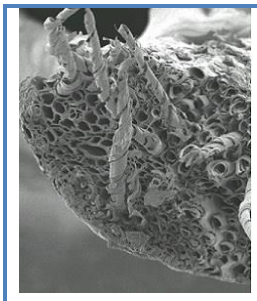
Cocoa crops are facing unprecedented onslaught of disease/pest, resulting in historically high prices that are posing problems on cocoa supply and demand. Therefore, **CARVES** project will be concentrated on carob valorization to develop a healthier alternative to cocoa based chocolate and explore the full value of carob and carob seeds.

Project 30

Novel building materials from side streams

Traditional biobased building materials are based on large pieces of virgin wood or composites using chemical resins and virgin fibres. Transition to a biobased economy requires use of residual and recycled resources and fully biobased materials to ensure optimal recycling and cascading possibilities.

New production methods, e.g. additive manufacturing, 3D printing, are currently focussing on creating architectural, design elements, where options for e.g. structural applications and repair of existing structures are disregarded. This project aims at developing a new type of materials based on cellulose fibres, in combination with other bio-polymers, e.g. nano-cellulose, lignin, alginate, protein, natural resins. This combination of materials can be processed using moulding techniques, profile extrusion and/or 3D printing.



Project 31

Bio-mechanical fibre extraction

The trend in the building, textile, packaging and other industries towards the use of biobased fibres focusses on alternative resources and environmental benefits. Topics that can be improved from the existing bio-based fibre processes include water use, pesticide use, (chemical-) waste production during processing and wastewater processing. Chemical extraction processes typically are large scale and require extensive side product commercialisation.

This project aims at smaller scale, biological and mechanical processes to extract fibres. Ideally side streams will be returned to the biosphere.

Public-Private-Partnerships in general

Subsidy conditions

- The above-described projects are being developed for application to the TKI subsidy, a Dutch governmental program sponsoring applied research. Each project requires at least one Dutch company partner, but additional partners from abroad are welcome to join.
- Granted projects receive 50% subsidy funding. The other 50% is contributed by industry partners, of which up to half (25% of total) may be in-kind.
- TKI projects typically have a running time between 2 and 4 years.

Expected contribution

- Total project budgets are typically between 0.8 and 2.0 M€.
- Participation costs per partner range from 20-50 k€ cash per year, with exceptions for small and medium enterprises (SME).
- Partners also contribute in-kind through participation in project meetings, contribution of materials, and/or performance of own experimental work.

2024 timelines

- 1 April 2024 the TKI call was published. The full call text is available online: https://www.kia-landbouwwatervoedsel.nl/beeld-hoofdpaginas/subsidies/pps/
- Partners are kindly requested to express their interest in joining proposals prior to 1 June 2024, at which time a selection will be made of proposals with sufficient support to continue.
- The deadline for full proposal submissions is 1 September 2024. At this time partner commitment must be firm.
- Early November 2024, consortia are notified if they have received the subsidy grant. Upon notification, the contracting phase starts.
- Projects kick-off as soon as contracting is completed (deadline: 1 April 2025).

Contracting terms

- The IP terms for a PPS consortium are governed by European state aid regulation. Please note that, as specified on the TKI site, the consortium agreement template is deemed mandatory and IP terms will not be modified. Parties engaging with these subsidized projects are advised to check the terms well in advance. For your convenience, the main concepts are summarized below.
- Foreground developed in the project accrues to the inventing party, most frequently the executing knowledge institute(s).
- Industry partners co-financing the consortium receive the right to apply non-protected Foreground directly and the first right to license any resulting protected Foreground (IP) for their field of use.
- Projects receiving subsidy are obliged to publish part of the results. A project steering committee with one representative per partner governs publication of project results.

For more information on any of these initiatives,
please contact the relevant Programme Manager
or have a look at our website:

www.wur.eu/call-for-partners

For general questions,
please contact Business Development Support:

wfbr.bd-support@wur.nl

We look forward to collaborating!