4.1 Final publishable summary report

4.1.1 Executive Summary

The European project "ECOpaint BIO-based FORmulations" (ECOBIOFOR), funded under the 7th Framework Program of the European Union, has worked on the development of bio-solvents from renewable resources through biotechnological routes and chemical processes based on the principles of the Green chemistry.

The aim is that the bio-solvents developed under the framework of ECOBIOFOR project will replace current petrochemical based solvents, promoting a more sustainable production and consumption by their use in coatings and paints.

A multidisciplinary and complementary consortium was set up in order to achieve these objectives: 5 SME-associations, 3 industries and 3 RTD performers. Within this project, the RTD performers gave support to the SMEs in the biotechnology and coatings & paints sector, helping in the development of more environmentally sustainable solutions that are technically and economically viable.

The R&D project, coordinated by TECNALIA RESEARCH & INNOVATION, has been carried out between September 2014 and November 2016 with a budget of € 2,318,000.

ECOBIOFOR responds to the need of replacing the current traditional petrochemical solvents used in the formulation of coatings, inks, adhesives, paints and varnishes by "green" components. ECOBIOFOR is therefore a project that will contribute to a more sustainable way of producing solvents from renewable resources, as it aimed to:

1- Develop novel sustainable chemical synthesis routes for commonly used solvents in coatings,

2- Develop reactive solvents (which do not evaporate but are built into the coating) and,

3- Validate these bio-based solvents in coatings.

The traditional petrochemical based solvents result from oil refineries followed by a few chemical steps. As an alternative route ECOBIOFOR will build on:

- Use of Renewable starting materials,

- Synthesis routes according to Green Chemistry,

- Biotechnological processes (enzymatic transformation),

- Paint -formulations with reduced VOC emissions.

A complete study of the feasibility of using renewable resources for synthesising bio-based solvents and then the production of coatings and paints using them has been carried out. Two different approaches have been developed:

* The FIRST Strategy for synthetizing SOLVENTS was via CHEMICAL transformations of renewable starting material following green chemistry rules and with simplified processes and methodologies.

*And the SECOND Strategy for synthetizing REACTIVE DILUENTS was via ENZYMATIC transformation of a molecule deriving from vegetable oil.

4.1.2 Summary description of project context and objectives

ECOBIOFOR project aims to **develop novel bio-based solvents using 'greener' chemical and biotech transformation processes from renewable raw materials.** The resulting solvents will be used in the **Coating Industry to contribute in the transition towards sustainable production and consumption patterns in Europe.**

Sustainability is also in the paint and ink industry a highlighted issue in the agenda, nevertheless in order to create a more sustainable paint or ink is essential a sustainable solvent. ECOBIOFOR project is focused in this idea and its first objective is to develop new bio-solvents which enable manufacturers to develop new coatings with higher bio-based content. Furthermore, ECOBIOFOR aims to boost the bio-based products market quota, at competitive prices, and facing the environmental and safety EU Directives affecting the Coatings Industry.

THE PROJECT FRAME

The European market for solvents. Considering recent data (source: article Clark et al[1]), solvents market is on the order of 20 million metric tonnes and European solvent production provides about one quarter of the worldwide market (5 million tons), with annual bio-based solvent use in the European Union projected to grow to over one MMT by 2020. Important sectors include paints and pharmaceuticals.

THE PROJECT

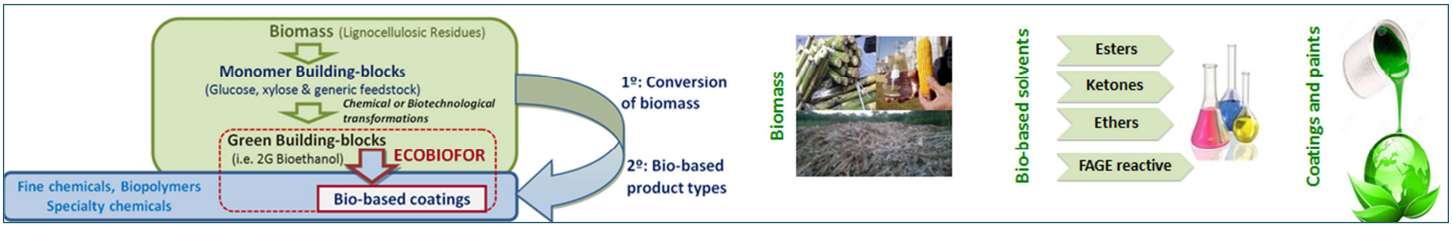
The European project "Ecopaint Bio-based formulations" (ECOBIOFOR), funded under the 7th Framework Program of the European Union, has worked on the development of new bio-solvents from renewable resources through biotechnological routes and chemical processes based on the principles of the Green chemistry.

The aim is that the bio-solvents developed under the framework of ECOBIOFOR project replace some current petrochemical based solvents, promoting a more sustainable production and consumption by their use in coatings and paints. With this project, TECNALIA, INPT (Laboratoire de Chimie Agro-Industrielle), IUCT and RTD-performers give support to the SMEs in the biotechnology and coatings & paints sector, helping in the development of more environmentally sustainable solutions that are technically and economically viable.

The R&D project, coordinated by TECNALIA RESEARCH & INNOVATION, has been carried out between September 2014 and November 2016 with a budget of € 2,318,000.

ECOBIOFOR responds to the need of replacing the current traditional petrochemical solvents by more sustainable components. The sector requires greener processes and components for such coatings, inks, adhesives, paint and varnishes as solvents are a basic and most used components in their processes and composition. The project is, therefore, a response to the sector´s needs to introduce more environmentally, friendly and sustainable products in the market.

The development of these biosolvents is a clear example of the potential for the application of biotechnology and green chemistry, generating patentable and economically viable technical results in the form of new products and technologies. This approach promotes the **transition of European industry of paints, coatings and solvents from a petrochemical to biological and sustainable basis.**



Concept of ECOBIOFOR project

[1] Int J Mol Sci. 2015 Aug; 16(8): 17101–17159. "Opportunities for Bio-Based Solvents Created as Petrochemical and Fuel Products Transition towards Renewable Resources". J. Clark, T.J. Farmer, A.J. Hunt, J. Sherwood.

Thus, the ECOBIOFOR project is designed to work towards the manufacture of biosolvents with high added value through the development of a **new generation of more sustainable paints** with a reduced carbon footprint while maintaining their properties and performance.

OBJECTIVES

- **Scientific Objectives**

1- Synthesizing some of the most used organic solvents in coatings, by starting from bio-resources and implementing new novel and simpler chemical routes to developed bio-based solvents. Selected solvents are organic solvents which are used both in solvents-based formulations (acetates/ketones) and in water-based ones (glycols as coalescents) in the coatings industry.

2- Development & optimization of enzymatic synthesis of a reactive solvent able to substitute aromatic and aliphatic solvents in oxidative drying coatings.

3- Looking for already existing green alternatives from SOLVSAFE (previous European project) and those existing in the market to be used in some specific coating processes. The solvents intended to be replaced are especially some aromatic hydrocarbons such as xylene, or toluene, which cannot be synthesized by a "bio" way.

4- Formulation of coatings/paints with the developed bio-based solvents.

5- Revalorisation of co-products from the syntheses in coatings and other sectors.

- **Industrial and Economic objectives**

1- Optimizing the price according to the process methodology looking for cost effective processes both in chemical and biotech syntheses.

2- Achieving bio-based products with high performance characteristics similar to those obtained from fossil oil resources-based systems in terms of purity in the delivery form and once incorporated in the paints for their industrial application and drying properties.

3- Bringing to the market new bio-based products: Development of "Ecopaint Bio-based Formulations", introducing "bio" ingredients in the form of solvents (LCA assessment).

- **Social and Environmental objectives**

1- Boosting the use of renewable resources to reduce dependency on fossil resources and reducing Carbon footprint by the increase of bio-based/renewable content in coatings formulations.

2- Reducing emissions of aromatic volatile organic compounds (VOC's) to the atmosphere in Coatings Industry, trying to substitute aromatic compounds, especially in the oxidative drying systems and in cleaning applications.

3- Improvement of the competitiveness of Biotech and Coatings SMEs (1009 SMEs are represented).

ECOBIOFOR CONSORTIUM

In order to achieve the objectives of the ECOBIOFOR project, a multidisciplinary and complementary consortium was set-up. The consortium included the whole supply chain, from the raw materials provider to the end-user. In dividing responsibilities and tasks among partners, an effort has been made to draw upon the relative strengths of each partner and to encourage active collaboration among the various SME-AGs and Other enterprises and/or end-users.

The ECOBIOFOR consortium consisted of **11 partners**: 5 SME-associations, 3 OTHERs, and 3 RTD performers.

• **5 SME-AGs:** representing 1346 members, 1009 of which are SMEs: 3 Biotech SME-AGs [ASEBIO (Spain), APBIO (Portugal), SBA (Switzerland)] in charge of promoting the use of bio-renewable resources. And 2 Coatings SME-AGs [CEPE (Belgium) & PROCOAT (Italy)] are in charge of promoting the new bio-based solvents in the coatings and paints area.

• **3 OTHERs:** 1 LARGE [DUBOIS (France)] as industrial solvent producer partner for developing new bio-based solvents from renewable raw materials and 2 SMEs [CASTELLANO (France) & IRURENA (Spain)] as "end-users" of the developed bio-solvents. They are paint and varnishes manufactures (of solvent & water-based systems respectively), which were in charge of assessing and validating the developed products in their specific formulations.

• **3 RTD performers:** TECNALIA (Spain), IUCT (Spain) & Laboratoire de Chimie Agro-industrielle from INPT (France) will conduct the research, synthesis and validation. The three RTDs are complementary, since two of them led the work intended for biomass sources and solvent production (INPT by chemical synthesis and IUCT by biotech way), and TECNALIA for development and application of the new developed products in specific coatings formulations.

Besides the 11 partners of the consortium, experts from ABENGOA BIOENERGIA NUEVAS TECNOLOGÍAS and from IHOBE have supported the project as EXTERNAL ADVISORY BOARD. As green raw material suppliers they contributed with advice and recommendations on green strategies and environmental topics.

The obtained results from the project are as follows:

- **<u>Bio-based solvents to replace their petrochemical counterparts</u>**
  - **Bio-ethyl acetate**, produced from bioethanol by esterification, using an ion-exchange resin as heterogeneous catalyst, can be used in ANY formulation of solvent-based coatings.
  - Two **butyl bio-acetates,** produced from bio-butanol by esterification using an ion exchange resin as catalyst: one synthesized from commercialized acetic acid, and the second one reusing the acetic acid produced from the synthesis of Bio-ethyl acetate according a coproduction pathway. They can be used in SELECTED solvent-based formulations.
  - **Bio-butyl glycol** produced from bio-butanol by etherification in the presence of an ion exchange resin. It is suitable as a coalescent for ANY water based paint formulation.

- **A Bio-based reactive diluent that would allow the reduction of VOCs in coating formulations**
  - **Allyl reactive diluent from FAME of used cooking oils (UCO).**
  - **Allyl reactive diluent from FAME of Camelina oil.**

These diluents (obtained from bio-based FAME by enzymatic transformation) would allow replacing a percentage of solvents of petrochemical origin present in the compositions (A paint formulation allowing for 3.5% solvent replacement in oxidative drying urethane alkyd paints has been tested).

- **Evaluation of co-products**

The co-products obtained within this project in the different developed processes were studied, with the objective of identifying new possible compounds of industrial interest. Within the synthesis process of bio-butyl glycol, **"BDE-21-by-pdts"** with high butanol content (72%) was identified as the most important co-product. Its main use would be the production of butanol (after its purification), to be reused in the bio-butyl glycol synthesis (recycled within the process), both for economic reasons and to generate less waste.

- **Use of bio-solvents developed under the European Solvsafe project in the design and synthesis of green solvents**

Some of them were selected and tested to be used as "auxiliary solvents":

- As cleaning agents for degreasing: Bio-solvent **G (111)** (1,2,3-trimethoxypropane), based on glycerol.
- As solvents for formulations:
  - Biosovents **LAOC2** (ethyl levulinate) and **G (114)** (1- (2,3-dimethoxypropoxy) butane) for solvent based systems
  - Biosolvent **G (101)** (1,3-dimethoxypropan-2-ol) for aqueous-based systems.

ROUTES FOR EXPLOITATION

For the exploitation of the outcomes of the project and based on the structure of the consortium, there are two main beneficiaries, biotechnological companies and paint companies (members of the SME-AGs biotech).

However, as the products are not fully based on a biotechnological production process and as product and paint manufacturers are themselves not involved in the production of the solvents they use, the scope of stakeholders had to be adapted. Internal (members of SME-AGs, Paint SMEs) and external stakeholders who may be interested in the exploitation have been identified.

A set of confidential and non-confidential material has been created in a joint effort among the SMEs, SME-AGs and RTD performers of the project. If interested in getting more information please contact with the project coordinator (TECNALIA).

	ECOBIOFOR has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under Grant Agreement nº [605215].

MORE INFORMATION

www.ecobiofor.eu

https://youtu.be/iwZvwjTuWJ4

4.1.3 Description of main S&T results/ foregrounds

4.1.3.1 RÉSUMÉ OF ACHIEVEMENTS

As **ACHIEVEMENTS OF ECOBIOFOR** registered during the Final project meeting November 25 in San Sebastian.

I. For solvents that were intended to come as close as possible to the petrol based equivalents 3 bio-based solvents (Ethyl acetate, Butyl acetate and Butyl glycol).

ACHIEVED:

Concerning Processes:

Three different bio-based solvents were achieved as alternatives in agreement with some Green Chemistry principles:

- **Bio-ethyl acetate** was produced from bio-ethanol by esterification, using an ion exchange resin as catalyst, and showed a high purity (99.9%), comparable to that of petro based version.
- **Two Bio-butyl acetates**, one synthesized from bio-butanol (esterification) and one prepared through a co-production pathway from acetic acid (produced during the production of bio-ethyl acetate) and bio-butanol. Bio-butyl acetate showed 94.35% of purity (co-production).
- **Bio-butyl glycol** was produced from bio-butanol by etherification and shows a purity of 90%. The supplement of components consists of a combination of glycols and butanol.

Concerning resulting products:

Bio-ethyl acetate is a solvent suitable for all the tested solvent-borne coatings formulations.

The chemical characteristics of Bio-butyl acetate came close to those of Petro-butyl acetate. Considering its suitability in some typical paint formulations, it has shown no negative impact. (Be it that impurities of water and alcohols in one of the Butyl-Acetates excluded its use in 2 component isocyanate paints).

Green metrics (Atom economy, Environmental Factor and Bio-based content) indicate the benefit of ECOBIOFOR processes of developed bio-acetates, compared to the traditional ones.

Bio-butyl glycol is suitable for its use in water-based paints as coalescent.

NOT ACHIEVED:

Concerning Processes:

A forth solvent (Methyl Ethyl Ketone) could not be produced with sufficient yield and purity and was not further evaluated in paints. The high residual water content made it not suitable for its use in solvent-borne systems.

Concerning resulting products:

- LCA values for acetates (as presented today) higher instead of lower than current petrol based solvents. But results are not definitive (validated) as the 2 processes are not made at comparable scale and operating conditions. More research on the process scale-up is needed to perform more accurate LCA comparison.
- The first estimations of the costs show that they are higher than the current petrol based solvents.

SUGGESTED STEPS FOR IMPROVEMENTS:

Concerning Processes:

Optimization of the processes of production of Bio-acetates and bio-butyl glycol at an industrial scale.

Concerning resulting products:

These both points, LCA and costs, may be improved if the processes by which they came from can be further optimized at an industrial scale.

II. A Bio-based Allyl reactive diluent that would allow taking VOC out of the paint formulation.

ACHIEVED:

Concerning Processes:

A new reactive diluent was synthetized from vegetable oil esters by an enzymatic procedure.

The allyl reactive diluent developed, due to its high boiling point (254ºC) is not considered as volatile organic compound (VOC).

Concerning resulting products:

This resulted in an allyl containing fatty acid ester which had the necessary properties for the required reactivity.

The new allyl reactive diluent can replace petrochemical based solvents.

The selected alkyd –urethane paint formulation allowed for the replacement of 3.5% of petro-based solvent.

NOT ACHIEVED:

Concerning Processes: -

Concerning resulting products:

Replacing was at least 3.5% of solvent by this reactive diluent in this particular paint formulation.

SUGGESTED STEPS FOR IMPROVEMENTS:

Concerning Processes: -

Concerning resulting products:

There may be other paint systems where higher replacement amounts are possible but that is beyond the scope and timeline of our project.

III. Characterisation of solvents that are different in chemical composition than the currently used typical petrol based ones.

ACHIEVED:

Concerning Processes:

Some Solvsafe solvents have been selected for coatings as cleaning agents and/auxiliary solvents.

Concerning resulting products:

The solvents that were evaluated for this part of the project were a result of an earlier project (Solvsafe EU project) and had not been evaluated for their suitability in paint formulations. Unlike the solvents produced under # **I** these solvents had non-typical chemical compositions for paints.

They were evaluated on properties like solvation, evaporation rate and suitability in paint formulations.

Some of them were selected for their use as “auxiliary solvents”:

- As cleaning agents: **G(111)** (1,2,3-trimethoxypropane) bio-solvent, based on glycerol.
- As solvents for formulations:

· **LAOC2** (ethyl levulinate) & **G(114)** (1-(2,3-dimethoxypropoxy)butane) bio-solvents for solvent-borne systems.

· **G(101)** (1,3-dimethoxypropan-2-ol) bio-solvent for water-borne systems.

NOT ACHIEVED:

Concerning resulting products:

Both in Solvent-based and in Water-based paints, they were slower in developing the required coating hardness upon drying.

Their estimated costs were 3 till 4 times the current level of above mentioned petrol based solvents.

SUGGESTED STEPS FOR IMPROVEMENTS:

Concerning resulting products:

Some of the candidate Solvsafe solvents were considered for cleaning/degreasing metal substrates before painting.

For which they were found to be suitable. Be it that the price also here is a factor 4 higher.

4.1.3.2 DESCRIPTION OF MAIN S&T RESULTS

The main S&T results of ECOBIOFOR project come from two approaches developed in the project:

Strategy 1: SYNTHETISING OF THE MAIN BIO-BASED SOLVENTS FOR COATINGS.

This strategy was investigated by economically competitive transformation processes to convent biomass into bio-based solvents via two routes: Chemical and biotech routes.

A) CHEMICAL ROUTE

Synthesis pathways for some traditional SOLVENTS via CHEMICAL transformations from renewable starting material following green chemistry principles and with simplified processes and methodologies were developed.

The obtained bio-solvents were:

1- **Bio-ethyl acetate** (**EtAc-NGReAnD3 isolated bio-ethyl acetate sample,** composition 99.93% EAc & 0.07% water) can be considered as a real copy of the reference commercial product because a high degree of purification has been achieved.

The new process avoids the disadvantages of using acids as homogeneous catalyst, using a heterogeneous ion exchange resins instead, leading to an easier separation of the catalyst, allowing the reuse of the resins for further esterification reactions and reducing the wastes.

2- For **Bio-butyl acetate,** two samples were produced:

2.1 The first one (**BAc-Cb-12 isolated bio-butyl acetate sample**, composition 98.8% BAc, 0.8% Butanol & 0.4% water)) by direct esterification of acetic acid with bio-butanol, using an ion exchange resin as catalyst.

It could be used in NC lacquers if special water removal additives such as the before mentioned Finma is used. However, it is not suitable in any case for PU 2K systems

2.2 The second one (**BAc-coprod_2 isolated bio-butyl acetate sample**, composition 94.2% BAc, 0.2% EAc, 5.5% Butanol & 0.03% water)) by reusing the acetic acid produced from the synthesis of Bio-ethyl acetate, previously described (co-production pathway).

It has been suitable for NC lacquers; however when tested in PU formulation, although the product was well-developed, the hardener suffered a NCO content reduction (8.4% NCO reduction in comparison with petrochemical hardener) due to the residual butanol content (5.5%) in its composition.

3- For the **Bio-Methyl Ethyl Ketone**, the **MEK-NG_DR bio-based MEK sample** retains a high percent of water. Much effort has been devoted to eliminate this water but it has not been possible. The last product still retains high residual water content (14.6%), which is not suitable for its use in solvent-borne coatings due to incompatibility problems.

4- In the case of **Bio-butyl glycol**, the process avoids problems related to conventional procedures (costly and harmful reagents, generation of by-products presenting difficulties to handle or treat) by using simple, cheap and non-hazardous reactants.

Although the purity of the **Bio-butyl glycol** (**BDE-21b-F3 and/or BDE-21b-F3#2 isolated bio-butyl glycol samples**, composition 90% butyl glycol, 4.9% ethylene glycol, 4% Butanol & 0.4% dibutyl ether) product reaches only a 90%, being a combination of butyl glycol, ethylene glycol and butanol, its behaviour has been good, being suitable to work as coalescent for these water-borne systems.

5- **Revalorisation of co-products**: Within the synthesis process of bio-butyl glycol, "**BDE-21-by-pdts**" with high butanol content (72%) was identified as the most important co-product. Its main use would be the production of butanol (after its purification), to be reused in the bio-butyl glycol synthesis (recycled within the process), both for economic reasons and to generate less waste.

B) BIOTECH ROUTE

REACTIVE DILUENTS were synthesized via ENZYMATIC transformation of a molecule deriving from vegetable oil.

The obtained biotech solvents were:

6- **Allyl Reactive Diluents** were developed from vegetable oils of different levels of quality, like the refined oils (high) or used cooking oils (low quality) and using a 'Green' production 100% biotech route, avoiding the generation of salts using enzymatic catalyst, becoming a sustainable and cost effective synthetic process.

The study of the different developments was made in two alkyd systems. Positive results were obtained in an urethane alkyd system including a 3.5% of solvent to adjust the viscosity.

Total replacement of the traditional solvent by the new Allyl reactive diluents:

6.1 **Allyl Reactive diluent from UCO** (Purified #4 Allyl Reactive diluent (from UCO) composition: 97% Allyl Reactive diluent, 1.5% FAME, 1.5% Allyl alcohol).

6.2 **Allyl Reactive diluent from Camelina oil** (Purified #6 Allyl Reactive diluent (from Camelina oil) composition: 93% Allyl Reactive diluent, 0.5% FAME, 6.5% Allyl alcohol).

Both products were synthesised from a vegetable oil (developed from UCO and from Camelina oil) and an Allyl modification by an enzymatic procedure.

Strategy 2: SEARCHING OF ALTERNATIVE GREEN SOLVENTS FROM OTHER SECTORS AS CLEANING AGENTS OR AUXILIARY SOLVENTS FOR COATINGS SECTOR.

7- A specific study was made to select **"auxiliary solvents" (cleaning agents or diluents**), considering existing green alternatives, previously detected in the SOLVSAFE project and from other industrial sectors. **5 options** (Solvsafe and market) have been validated for cleaning and/or auxiliary uses.

For cleaning applications (contaminants such as silicone and lubricant oils, nail polish and/or alkyd remains:

- Coming from the market: **Galaster BL 97, Galasolv NF 62 commercial solvents,**
- Coming from Solvsafe: **G (111) green alternative.**

For using as auxiliary diluents in coatings formulations:

- **LAOC2 Solvsafe green alternative** for solvent-borne coatings systems.
- **G (101) Solvsafe green alternative** for water-borne coatings systems.

4.1.3.3 FOREGROUND

Five exploitable Foreground results have been identified:

ECOBIOFOR Result No.1

Process for the development of Bio-ethyl acetate as an alternative to the petro-based equivalent under Green Chemistry principles.

ECOBIOFOR Result No.2

Processes for the development of two Bio-butyl acetates as an alternative to the petro-based equivalent under Green Chemistry principles. One synthesized from bio-butanol (esterification) and one prepared through a “coproduction” pathway from acetic acid (produced during the production of bio-ethyl acetate) and bio-butanol.

ECOBIOFOR Result No.3

Process for the development of Bio-butyl glycol with a purity of 90% produced from bio-butanol by etherification under Green Chemistry principles. The obtained co-product "BDE-21-by-pdts" from the purification step of bio-butyl glycol needs to be recycled to improve the sustainability and economic aspects of the process. From this co-product, n-butanol can be enriched by distillation and can be reused as starting material in the butyl-glycol synthesis. Furthermore, the residual di-n-Butyl ether could serve (after further purification) as specialty solvent for the replacement of Tetrahydrofurane in Grignard, Wittig and other organo-metallic reactions and for coatings of CD-R.

ECOBIOFOR Result No.4

Process for the production of a Bio-based Allyl reactive diluent which was synthetized from vegetable oil esters by an enzymatic procedure. This diluent would allow taking VOC out of the paint formulation; it has been tested in an alkyd paint formulation replacing 3.5% solvent.

ECOBIOFOR Result No.5

New applications of Solvsafe solvents selected and evaluated for their suitability in coatings as cleaning agents and/or auxiliary solvents. As cleaning agents: G(111) (1,2,3-trimethoxypropane) bio-solvent, based on glycerol. As solvents for formulations: - LAOC2 (ethyl levulinate) and G(114) (1-(2,3-dimethoxypropoxy)butane) bio-solvents for solvent-borne systems. - G(101) (1,3-dimethoxypropan-2-ol) bio-solvent for water-borne systems.

4.1.4 Potential impact and main dissemination activities and exploitation of results

4.1.4.1 POTENTIAL IMPACT

A wider discussion on productivity, sustainability and change in economies, sketching the opportunities, the risks and the economic and policy impacts entailed by a confluence of new technologies (digital technologies, new materials (the bio and the nano) and new processes) is taking place actually within administrations, research centres and academia, the enterprises and the society. All these technologies, materials and processes are in progress in Europe and will be available in the next future.

Considering recent data (source: article Clark [2]et al), solvents market is on the order of 20 million metric tonnes and European solvent production provides about one quarter of the worldwide market (5 million tons), with annual bio-based solvent use in the European Union projected to grow to over one MMT by 2020. In Europe, the paint and coating sectors are the areas where more solvents are consumed in their different formulations (50-70 wt. %). European Directives (IPPC, SE Solvents and Paints Directives) are pushing companies to develop greener solutions. Bio-based solvents will fit the EU initiatives for resource efficiency.

ECOBIOFOR project aims to develop novel **bio-based solvents using 'greener' chemical and biotech transformation processes from renewable raw materials**. The resulting solvents will be used in the Coating Industry to contribute in the transition towards more sustainable production and consumption patterns in Europe.

Sustainability is also in the paint and ink industry a highlighted issue in the agenda, nevertheless in order to create a more sustainable paint or ink a sustainable solvent is essential. This is the focus of the ECOBIOFOR project with its first objective to develop new bio-solvents which enable manufacturers to develop new coatings with higher bio-based content. Furthermore, ECOBIOFOR aims to boost the bio-based products market quota, at competitive prices, and facing the environmental and safety EU Directives affecting the Coatings Industry.

The aim is that the bio-solvents developed under the framework of ECOBIOFOR project replace some current petrochemical-based solvents, promoting a more sustainable production and consumption by their use in coatings and paints. Furthermore, with this project, TECNALIA, INPT and IUCT, ECOBIOFOR RTD-performers give support to the SMEs in the biotechnology and coatings & paints sector, helping in the development of more environmentally sustainable solutions that are technically and economically viable. "Ecopaint Bio-based formulations" (ECOBIOFOR) responds to the need of replacing the current traditional petrochemical solvents by more sustainable components.

The development of these biosolvents is a clear example of the potential for the application of biotechnology and green chemistry at industrial level, generating economically viable technical results in the form of new processes and technologies. This approach promotes the **transition of European industry of paints, coatings and solvents from a petrochemical to biological and sustainable basis**.

For a real implementation of the results and outputs achieved during the project, several aspects have to be taken into account, like the residues of water or other substances that may impart the network building and therewith the performance of the paint formulation. Further into the project also the economics of these new synthesizing routes require a careful study. Commercially produced quantities should arrive at the similar level of the solvents derived from petrochemical sources. This is a challenge indeed, especially with today's low oil prices. There certainly is still a lot to do to optimize the processes developed in the project before the biomass route holds a promising future. The Life Cycle Assessment, covering the whole production process and starting materials, helps to demonstrate the opportunities of these processes and results but also shows hot spots where improvement and redesign is required.

[2] Int J Mol Sci. 2015 Aug; 16(8): 17101–17159. "Opportunities for Bio-Based Solvents Created as Petrochemical and Fuel Products Transition towards Renewable Resources". J. Clark, T.J. Farmer, A.J. Hunt, J. Sherwood.

Nevertheless, this project will open the door to new opportunities and innovation responding to the sector´s needs to introduce more environmentally friendly products in the market.

4.1.4.2 DISSEMINATION OF KNOWLEDGE

To ensure effective technology & knowledge transfer activities, effective communication and dissemination tools were defined. The dissemination actions aimed to keep all the stakeholders fully informed about the project status, planning, results and main achievements in order to obtain transparency for all partners and actors interested.

Dissemination of knowledge has been carried out at two different levels: within the consortium (internal) and outside of the consortium via SME AGs to their members and stakeholder communities (external) and entities from associations' networks.

Although all participants in the project are responsible for the dissemination of results, the SME Associations have a relevant role in coordinating and ensuring the dissemination activities in the coating industry sector (by associations CEPE and PROCOAT), as well as in the biotech sector (by associations ASEBIO, APBIO and SBA). From the dissemination point of view, it has been fundamental to increase the visibility of the project, stimulating the interaction between partners, improving internal communication, and working towards the outreach of most promising results derived from the project.

All the information generated in the ECOBIOFOR project has been circulated among all the partners of the consortium. It offered the opportunity to have the greatest possible cooperation and improve the transfer of knowhow. TECNALIA with the collaboration of ASEBIO and CEPE (SME-associations) were responsible for the optimal circulation of this information within the partners. Last results and relevant information have been elaborated and distributed amongst them as the project moved towards the development of bio-based solvents and formulations.

The specific objectives of outreach and external communication were:

- To inform the target audience about the Project Idea: objectives; reason for its creation; results; etc.
- To establish and maintain mechanisms for effective and timely communication.
- To coordinate all levels and types of communication in relation to the project.
- To disseminate the progress and results achieved during the project.
- To disseminate and transfer new findings on solvents development for interested or related entities in the chemical, biotech and painting industry to promote future collaborations and further research.
- To engage in effective, transparent and understandable communication with the society in general, encouraging more eco-friendly and greener processes.

The project has to reach different kinds of audiences. The types of public we have found are:

- Internal direct audience:
  - Consortium partners.
  - Stakeholders responsible for management and coordination within the European Commission.
- Direct external beneficiaries:
  - Innovative and / or technology-based companies and SMEs.
  - Intermediate bodies such as research institutes, universities, etc. and specialised companies participating in innovation.
  - Coatings and biotech clusters, Associations and Technology Platforms.
  - Coatings end users.
  - Other potential users and consumers (cosmetics, chemical industry, etc.).
- General Audience:
  - Agencies and public bodies at European level.
  - Society in general.

METHODOLOGY

The Plan details actions and activities to ensure an effective communication of the project objectives and its results. It includes the lines of action and dissemination tools:

- Creation of a logo and corporate image.
- Project Website (www.ecobiofor.eu).
- Link to ECOBIOFOR project in each partner website.
- Promotional Materials: a set of 5 materials were developed at the closure of the project (see Deliverable 11.5).
  - o A final brochure has been generated with general project information, objectives and final results
  - o Promotional material for seminars, press conferences, meetings, workshops and conference tables has been set up.
- Participation and attendance to scientific and industry conferences and networking events.
- Press Releases / Articles.
- News and events on the website of the project.
- Activities to reach society (creating awareness about circular economy and ecological processes through press releases, activities with journalists, social networks, etc.).

The objectives of the dissemination strategy and the target groups have been identified during the different stages of the project according to the several phases that we defined and identified. The stakeholders, used tools, and dissemination approaches have been changing as new needs and outcomes were defined or generated, therefore the strategy became more specific to focus on delivering value to end users and interested parties while we continued to achieve the project milestones. The **different phases** have been defined as follows:

- **Phase I M1 till M12: September 2014 till September 2015**

Character of dissemination content: announcement and explanation of project (objectives, partners, etc.). The information provided in this phase is general, showing overall objectives and main expected outcomes in the project. This phase is looking to inform to the general public about the existence of the project.

Related SMEs informed about the project to be able to monitor and follow the proceedings, evolution and main results obtained.

- **Phase II M12 till M27: October 2015 till September 2016**

Character of dissemination content: Interim status of project (efforts done so far; first milestones, etc.).

More realistic information about the project status has been shared between consortium partners and stakeholders to develop the outline of the real evolution achieved within the project.

- **Phase III M23 till M27++: July 2016 till December 2016 and beyond**

Character of dissemination content: results (achievements and next steps, etc.).

In this phase, more detailed information about achieved outcomes has been shared with the public and association members in order to define real interests and exploitable opportunities within SMEs participating in the project and the partner associations. This phase complement phase II.

DISSEMINATION MATERIALS

1. LOGO AND CORPORATE IMAGE

A specific project identity was created in order to reinforce and establish a project's external image via a **logo** which reflects the ECOBIOFOR project concept in a simple way, very related with the paint and coating industry (paint can with bio-based content) and the support of the biotechnology (green colour).

Ecobiofor Logo.

2. WEBPAGE OF THE ECOBIOFOR PROJECT

The project website is hosted by TECNALIA and contains general information about the project, work plan, objectives, partner information and contact information. A more detailed description about the ECOBIOFOR webpage is shown in the deliverable D 11.1 "*Setting up of a project webpage*". It will be active for a period of 5 years from the beginning of the project (until the end of 2018).

3. LINK TO ECOBIOFOR PROJECT IN EACH PARTNER WEBSITE

ALL PARTNERS inserted a link in their own website to the ECOBIOFOR website (www.ecobiofor.eu), explaining if possible briefly the project and its objectives.

4. PROMOTIONAL MATERIAL

The Promotional materials include brochures used in events and official fairs. The designed initial "ECOBIOFOR - Brochure" includes:

- General data: Project acronym, Grant Agreement No., Title of the project, logo, webpage of the project, etc.
- Objectives: What is the project aiming to achieve?
- Main lines of the project
- Project consortium

A final brochure (Annex 1) has been prepared with the most important **non-confidential results** achieved in the project:

⇒ 3 bio-based solvents (Ethyl acetate, Butyl acetate and Butyl glycol) that were intended to replace petro-based equivalents.
⇒ A bio-based reactive diluent that would allow taking VOC out of the paint formulation.
⇒ Revalorisation of co-products
⇒ Use of already existing bio-solvents from previous Solvsafe project.

4.1 DURING THE COURSE OF THE PROJECT

More than 1.000 copies of promotional material have been shared during the most important biotech and painting industry events (Bio-Europe 2014 & 2015 & 2016, BioSpain 2014 & 2016, Biopharm 2014 & 2015, BioJapan 2014, Biotech Showcase 2015, Nordic Life Science Days 2014 & 2015, Biotechnological use of untapped biomass, 11th International Conference on Renewable Resources and Biorefineries, BIO-Europe Spring 2015 & 2016, Biomeet 2016, CEPE annual conference 2015 & 2016 , i-net Business Event; Chemical Industry: Opportunities in the Basel Area, Ramspec 2016, EFIB 2016, etc.). The Consortium will continue to attend the main fairs and events that are of interest for the dissemination of the project results.

4.2 AT PROJECT END

Some practical material has been prepared in order to use them in the dissemination activities and to araouse the interest of stakeholders and interested entities. See table in Deliverable 11.5:

- FLYER with summary of publishable results (non-confidential),
- List of publishable results (List of the non-confidential results achieved),

- General ppt with non-technical information (non-confidential),
- Ppt with technical details (non-confidential),
- Video Clip (https://youtu.be/iwZvwjTuWJ4),
- Webpage (www.ecobiofor.eu, continuous update of information).

5. PARTICIPATION AND ATTENDANCE AT SCIENTIFIC CONFERENCES AND NETWORKING EVENTS

By contributing to scientific and networking conferences and sectorial exhibitions, the consortium aims to present main objectives and outcomes of the project, to stimulate stakeholders' interest. The consortium decided what developments to show in the events according to their exploitation strategy and status. The attendance and participation at national and international events afforded us to find of potential customers and to increase market opportunities. In those events not suited for an ECOBIOFOR project presentation, information was shared trough the dissemination of material such as brochures or posters, and one-to-one meetings.

ECOBIOFOR project was presented in the following fairs or conferences:

- BioSpain 2014 in Santiago de Compostela, Spain, organised by ASEBIO, where Carlos Vaca-García, from an RTD performer, explained the most interesting points and objectives of the ECOBIOFOR project, and its relevance in the application of greener processes in the industry for the development of the bioeconomy.
- CEPE conferences 2015- 2016 where the leading players in the European paints and coatings industry met. It was shown the increasingly importance for modern companies to discharge their environmental and social responsibilities and to integrate them into their business models. CEPE took the opportunity to raise more info about ECOBIOFOR objectives.
- Ramspec 2016 fair in Milano, where the session "Raw materials and chemicals for the formulation of green coatings" took place, in which PROCOAT presented and gave information about the results of the project. The edition was especially dedicated to the raw materials, chemicals, specialties and related products manufacturers and distributors, involved in the formulation of chemical products.
- HABIC-Innovative materials, where Tecnalia presented the project and its results in the conference "Recubrimientos ecológicos" where Spanish companies of paint and varnishes were invited (20 attendees) in December 2016.

The project and its results have been disseminated as well in:

- Coatings fair: "International Fair for Paint, varnish, glues and adhesives" (www.eurocoat-expo.com), Eurocoat, European coatings show, Biobased materials for industrial coatings, Green coating workshops, Advances in coatings Technology (ACT), etc.
- Relevant biotech fairs, such as: BIO International Convention, BioEurope, BioEurope Spring, BIOSPAIN, BIOLATAM, Biomeet, Biotech Showcase, BioJapan, etc.
- Industry conferences and fairs: European Forum for Industrial Biotechnology and the Biobased Economy (EFIB), Bioeconomy workshops, Green Chemistry congress, etc.

6. PRESS RELEASES & ARTICLES

The dissemination plan also focused on the transfer of knowledge to main stakeholders at national and international level, through the publication of press releases and articles in a variety of e-journals: scientific, sectorial, business or professional journals.

Publications, articles and press releases informed about and disseminate the project progress, achievements, challenges and results. It has been done through specific material which compiles in a direct and clear way the status of the project and main implications of results obtained (tables of the data sheet: product sheet and process sheet).

At this moment, the following articles have been published and/or will be published linked to the project:

- **European Biotechnology News** (December 2014) where we did an introduction of the project and its opportunities for the paint and coating sector trough the title "**Paint it green**". It reaches Life sciences enterprises in the European Union.
- **ETA- Florence magazine** (April 2015) the magazine published by ETA-Florence since 2012. BE-Sustainable is a source of news, information and resources on biomass, bioenergy and the bioeconomy. The subject of the project fits well into the editorial scope of the magazine, which was distributed to over 25.000 contacts globally via newsletter and social media. The publication was free of charge.
- **CEPE Formula** (July 2015), quarterly bulletin with approx. 1500 recipients from paints companies.
- Article for the **magazine 'Verf & Inkt'** of the Dutch Paint and Ink Association VVVF (December 2015) Dutch version.
- **Ihobe article** published in English, Euskera and Spanish (December 2016). Ihobe is the public agency of environment, belonging to the Department of the Environment, Territorial Planning and Housing of the Basque Government. Ihobe's mission is to support the Basque Government in developing environmental policy and spreading the culture of environmental sustainability in the Basque Country. This article was also published in **RETEMA** (Revista técnica del Medio Ambiente) magazine.
- An article for **Coimbra's review** has been developed for its publication in March 2017.

Posters have been elaborated and presented in four events:

- ECOBIOFOR: a European project on ECOpaint BIO-based FORmulations; **11th International Conference on Renewable Resources and Biorefineries 2015**, 3-5 June 2015, York (UK)
- Life Cycle Assessment of bio-based solvents for paint and coating industries; **SETAC Europe 2016** – May 22nd-26th 2016 – Nantes (France).
- ECOBIOFOR: a European project on ECOpaint BIO-based FORmulations; **Biomeet 2016**, on the 8th April 2016, Portugal.
- ECOBIOFOR: a European project on ECOpaint BIO-based FORmulations; **ACT'16**, on the 8th November 2016, in Poland.

ECOBIOFOR has appeared in different reports, bulletins and publications from project partners:

- **ASEBIO Annual Report** and "News and trends from the Spanish Biotech Sector" bulletin (July 2015). The ASEBIO Annual report is created by ASEBIO where general information of ECOBIOFOR (brochure and meetings of the project) was included. This report was launched in July in 2016 in an event where ASEBIO invited big personalities of the biotech sector. Around 700 reports were printed. It was also translated to English and uploaded in the **webpage of ASEBIO** which has received almost 25.000 visits. It has been also mentioned and presented in news about ASEBIO activities in the **monthly bulletin**.
- **SBA bulletins (NTN Bulletin**) for NTN Swiss Biotech members (300 copies) and **SBA Annual Reports** for Swiss Biotech Association members (250 copies), **e-newsletters.**
- **TECNALIA express**; Tecnalia internal web, where related news about ECOBIOFOR project were launched and shared.

7. ACTIVITIES TO REACH SCIENCE AND SOCIETY

Public support is needed for political and structural changes. The engagement with society in its broadest sense aims to enable citizen empowerment and decision-making. This includes the use of science by society and the provision of scientific advice to policy makers for the benefit of society.

To ensure public support for a continued development and application of biotechnology in these processes, it is essential to ensure that public opinion is based on scientific facts and knowledge, and long term benefits. To achieve this objective, consortium has developed campaigns to disseminate within general public specific information about the project and its consequences for economy and a sustainable production of solvents for example:

1) Compiling data for LCA studies in a clear and direct way to facilitate the reflection on the need of more sustainable processes (fact sheets).

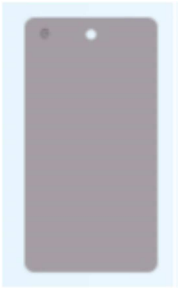
2) General presentation of the project.

3) Brochure with the principal achievements.

4) Creating materials to show in the different events. Ecobiofor paints formulations were applied over different substrates.

OAK WALNUT IROKO METAL



5) Webpage of ECOBIOFOR (www.ecobiofor.eu).

Also, relevant information about the project has been published in a variety of magazines, both in e-journals and printed press, to explain the implications of the expected results and their implementation within the coating industry.

8. TRAINING WORKSHOPS

In the last meeting of the ECOBIOFOR project which took place in the 24-25th of November in 2016, all the Associations involved in the project invited members to participate in an open session where TECNALIA explained the project and the principal results achieved. This open session was followed through webex by four companies. This is the list of the attendees:

- BIOMIMETX, LDA APBIO; Mr. Gonçalo Costa (goncalo.costa.biomimetx@gmail.com); Ms. Cristina Simões (cristina.simoes.biomimetx@gmail.com).
- THE NAVIGATOR COMPANY APBIO; Ms. Mariana Belo Oliveira (marianabelooliveira@gmail.com).
- SMALLMATEK APBIO; Ms. Claudia Rocha (claudia.rocha@smallmatek.pt).
- XYLAZEL ASEBIO; Mr. José Ramón Alvarez (JR.Alvarez@xylazel.com).

FUTURE EVENTS

In March 2017, ASEBIO with the help of the Spanish Chemical Industry Federation is preparing a workshop to show the results of the ECOBIOFOR project to Spanish chemical and biotech industries.

In 2017, the SME-AG will continue disseminating the project and the results to increase the awareness in the results of the project with meetings, bulletins, Industrial Biotech Workshop, etc.

4.1.4.3 EXPLOITATION OF KNOWLEDGE

1. FOREGROUND

The RTD performers have been 100% paid for their work, therefore the SME-AGs and SME Participants obtain full ownership of the Foreground.

The foreground IP is owned by the 5 SME-AGs (APBIO, ASEBIO, CEPE, PROCOAT &SBA) and by 2 SMEs (CASTELLANO & IRURENA) as defined within the joint ownership agreement. SME-AGs have the right to sub-license or transfer their rights to one or more of their member companies according to the procedure defined within the joint ownership agreement. The SME-AG and other partners' areas of application are defined as follows:

- SME-AG Biotech: ASEBIO, APBIO and SBA- Biotechnology sector
- SME-AG Paint: CEPE and PROCOAT - Paints and varnishes industry
- SME Paint:

⇒ IRURENA - manufacturing and sale of products such as varnishes, solvents and stains for
  - wood and furniture industry. Water-based formulations for lab-scale and semi-industrial
  - scale prototyping.

⇒ CASTELLANO - manufacturing and sale of products such as paints, solvents and other
  - chemical products, mainly high performing industrial coatings. Solvent-based formulations
  - for lab-scale and semi-industrial scale prototyping.

As per D1.1 Consortia Agreement, the RTD performers (the main researchers / technological developers) are granted an unlimited, royalty-free right to use the Foreground generated during the Project for subsequent research activities including third-party research, provided the third party does not have direct access to the Foreground or confidential information of the SME-AGs and SME Participants. If Foreground is required for exploitation of follow-on third-party access has to be negotiated with the Owners.

The **major objectives that ECOBIOFOR** aims to obtain were:

#1: Copies of mineral oil based oxygenated solvents (a near 1:1 replacement in paint formulations)

#2: Reactive solvents via biotech synthesis (leading to VOC reduction in emission)

#3: Revalorisation of co-products (non-purified reaction mixtures)

#4: Main ECOBIOFOR project results from the Solvent replacements for water-borne and solvent-borne paint and coatings formulations, and cleaning agents.

In addition to the performance objectives, such products should also be **sustainable** from the point of view of:

A) Chemistry (energy consumption, use of catalysts, exposure risks for human or environment),

B) Efficiency (yield and purity),

C) Economics (comparable cost price).

2. INTEREST ON RESULTS AND DISTRIBUTION OF OWNERSHIP RIGHTS

For paint and coating industry, the replacement of typical solvents with certain green solvents would be only possible if economic and technical issues and performance were maintained or improved.

The SME-AGs and the SMEs agreed that, at this stage of development at the project end, the readiness level of the products, processes and technologies are not mature enough for large scale production and commercialization in the coatings industry. As explained in the outcomes description, further development steps are needed to reach those markets; so there is still a necessity of improvement in price and LCA for being competitive.

Thereafter, the potential market for the outcomes at this stage of readiness is the biotechnological companies and chemical producers, one step behind in the value chain towards end user, which may be interested in the processes developed within ECOBIOFOR scope. Thus, the SME-AG Biotech (ASEBIO, APBIO and SBA) will have an important task in the exploitation, to identify suitable members or other SMEs interested in the further development of the Foreground toward commercially available products.

One of the members of ASEBIO, Xylacel, which is a company part of Pharmamar Group, dedicated to the manufacture and marketing of wood protection and decoration products, signed in November 2016 a Confidential agreement to obtain more information about the project. However, in the same line of paint companies, they are also waiting for manufacturing companies to step in and to develop the processes to improve prices of Bio-glycol and Bio-butyl acetates. If so, they might either be interested to in-license the production scale process know-how or to purchase on the market.

3. ROUTES FOR EXPLOITATION

For the exploitation of the outcomes of the project and based on the structure of the consortium, there are two main beneficiaries identified, bio-technological companies and paint companies (members of the SME-AGs biotech).

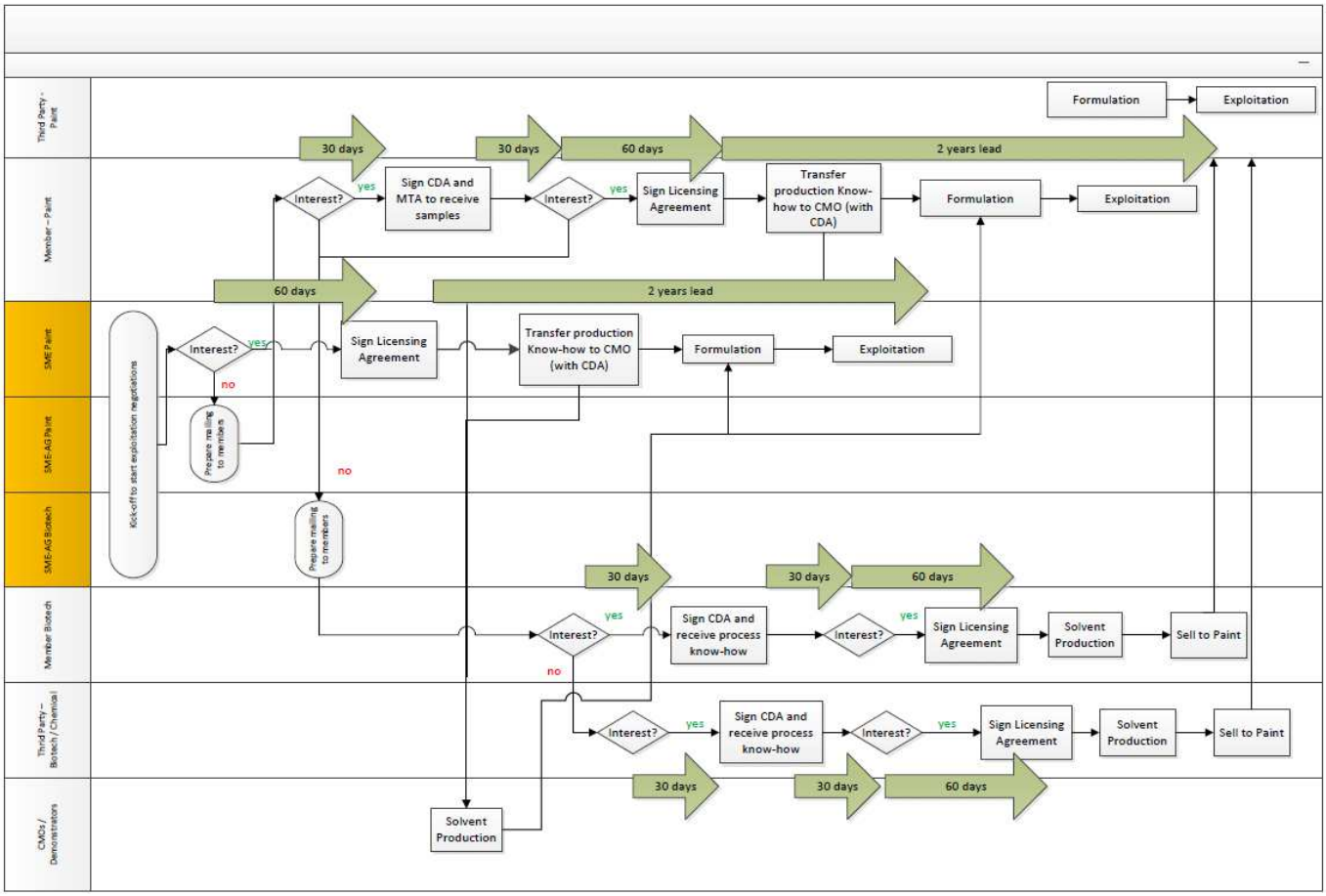
However, as the Foreground of the project is neither a fully biotechnological production process nor product and paint manufacturers are themselves not involved in the production of the solvents they use, the scope of stakeholders had to be adapted. Internal (members of SME-AGs, Paint SMEs) and external stakeholders who may be interested in the exploitation were identified.

Regarding the access to the project results, we have grouped them in order of priority, based on the involvement within the Ecobiofor project as owners or member companies of owners:

- Paint Manufacturers (end user of solvents):
  - SME Paint (IRURENA and CASTELLANO),
  - Member Paint (member companies of the project SME-AGs Paint).
- Bio-chemical and chemical companies (producers of solvents)
  - Member Biotech (member companies of the project SME-AGs Biotech),
  - Third Party – Biotech / Chemical (non-member companies of the project SME-AGs Biotech).

A final schedule about the exploitation of results via a decision flow-diagram has been created in order to set the chain of actions to reach the key stakeholders defined above and to offer them a period of (partial) exclusivity on the results. Some issues have to be considered:

- The costs and ownership of the patent or other Intellectual Property Right is assumed by the owner.
- The RTDs are the inventors of the results; however, within the Ecobiofor project they have been fully reimbursed for their work and therefore are not owners of the Foreground.
- The lack of response by the deadlines marked in the diagram would be considered as an implicit refusal of rights on the results.



The Paint SME-AGs have received no in-licensing interest from their paint SMEs, they as well do not have any solvent production capacities. At this stage of the project, the owners offer the in-licensing of foreground to first their members and after a grace period of exclusivity to non-members.
To spark interest within the group of biotechnological or chemical production companies, non-confidential information material has been prepared. For the first offering of the results non-confidential material has been prepared by the consortium in order to provide enough information to know the scope of the offering but, at the same time not jeopardizing the protection of the outcomes.

After signing of a CDA specifying the Foreground of interest (#1 bio-EtAc, bio-BAc and bio-BG, #2 Reactive Allyl diluent) the interested companies will receive additional information, classified as confidential and giving some more detailed information on characteristics and processes. Full knowledge of the Foreground of interest (#1, #2) generated within the project will be transferred to the SMEs or Associations SME members ONLY with an in-licensing agreement, established and determined as specified within the Joint Ownership Agreement. The Joint Ownership Agreement defines the procedures on transferring know-how by licenses as well as the voting rights and composition of owners per defined Exploitable result.

As paint companies are not interested in the production of the solvents, the protection of their industrial and trade secrets through a two-year lead time has proven obsolete.

EXPLOITATION MATERIALS

The set of confidential and non-confidential materials to carry on the Exploitation Plan has been created in a joint effort among the SMEs, SME-AGs and RTD performers of the project.

	Access to information				
Results and technical information derived from the project	Public	SME members	SME's which signed the CDA	SME's that signed licensing agreement	The consortium
Publishable Summary prepared for EU	YES	YES	YES	YES	YES
List of publishable project results (Approved in the Final meeting)	YES	YES	YES	YES	YES
General presentations in pdf format "Open session" and other presentations (i.e. Ramspec ppt presented by Procoat))	YES	YES	YES	YES	YES
Technical confidential ppts (workshop)	NO	NO	YES (for the results specified in the CDA)	YES (for the results in-licensed)	YES
Deliverables	NO	NO	YES (for the results specified in the CDA)	YES (for the results in-licensed)	YES
Résumé of Achievements (Approved in the Final meeting)	NO	NO	NO	YES (for the results in-licensed)	YES
Progress indicators tables - final version. (Approved in the Final meeting)	NO	NO	YES (for the results specified in the CDA)	YES (for the results in-licensed)	YES
REPORTING DOCUMENT: RP1	NO	NO	NO	YES (for the results in-licensed)	YES
REPORTING DOCUMENT: RP2	NO	NO	NO	YES (for the results in-licensed)	YES
REPORTING DOCUMENT: FINAL	NO	NO	NO	YES (for the results in-licensed)	YES

COLLABORATIONS

Due to the research developed within the project, several RTD performers employed and recruit specialized personnel with skills for the development of the expected tasks and experiments.

This kind of action not only strengthens relations with the academia and the research centers, but also promotes employment and enriches the educational programs working in a project closely related with the work and models of the public-private collaboration.

4.1.5 Address of project public website and relevant contact details

- **PROJECT PUBLIC WEBSITE:**

Project websites are one of the main communication tools of projects funded under the EU 7th Framework Programme. To ensure maximum visibility to the ECOBIOFOR objectives and results, it has been set up a project website registered in the "eu" domain and with an intuitive URL to increase hit rates: www.ecobiofor.eu .

More information in the web: https://youtu.be/iwZvwjTuWJ4 .

- **RELEVANT CONTACT DETAILS:**

Coordinator Contact:
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E-mail: idoia.etxeberria@tecnalia.com

Partners Contact:
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APBIO ASSOCIACAO PORTUGUESA DE BIOINDUSTRIA (SME-AG, Portugal), **Sara Monteiro**
E-mail: smonteiro@p-bio.org

SWISS BIOTECH ASSOCIATION (SME-AG, Switzerland), **Cathy Kroll, & Domenico Alexakis**
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PROCOAT CONSORZIO PER LA PROMOZIONE DEI PRODOTTI VERNICIANTI E RICOPENTI (SME-AG, Italy), **Claudio Pagella**
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CONSEIL EUROPEEN DE L'INDUSTRIE DES PEINTURES DES ENCRES D'IMPRIMERIE ET DES COULEURS (SME-AG, Belgium), **Jan Van der Meulen**
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