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SP11 – PROJECT MANAGEMENT WP11.1 – Project Management

Deliverable report

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PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)*	
RE	Restricted to a group specified by the consortium (including the Commission Services)*	
CO	Confidential, only for members of the consortium (including the Commission Services)	

* In case of dissemination level of PP/RE, the persons agreed to have an access to the document are: Not applicable

Content

I Final publishable summary report

EuroBioRef

EUROpean multilevel integrated BIOREFinery design for sustainable biomass processing

I.1. Executive summary

EuroBioRef (www.eurobioref.org) deals with the entire process of transformation of biomass, from non-edible crops production to commercial products. It involved 29 partners from 15 countries.

Main results

- 5 **lignocellulosic plants** (willow, giant reed, miscanthus, switchgrass, cardoon) and **10 oil crops** (castor, crambe, cuphea, lesquerella, jatropha, safflower, as well as sunflower, camelina and rapeseed for comparison) were grown;
- **Large test fields** were set: **willow and crambe** in Poland, **giant reed and safflower** in Greece and **castor** in Madagascar;
- **Win-win culture rotation strategies between food and non-food crops** were developed;
- **A biomass supply logistics model has been developed** and populated with data for 4 crops (willow, castor, safflower and giant reed);
- **Efficient biotech technologies** were developed to yield platform molecules from glycerol and biomass hydrolysates, **outperforming the current state of the art;**
- A **brand new pilot plant in Norway able to operate more than 50 kg of dry lignocellulosic materials per hour** was constructed, using a **new and versatile pretreatment process** validated at the lab scale on miscanthus, giant reed and switchgrass. Full-scale unit is planned for 2017;
- **24 patents** were filed (1.04 patent per M€ public money);
- **29 scientific papers** were published (to date, 1.26 paper per M€ public money), and more are under preparation;
- **A 20 min video explaining the project** is available on the EuroBioRef Website together with a 6 min video accompanied with a *ca.* 70 pages booklet both summarizing the outcomes of the project (www.eurobioref.org);
- **A book 'Biorefinery: From Biomass to Chemicals and Fuels'**, Ed. by Aresta, Michele / Dibenedetto, Angela / Dumeignil, Franck, ISBN: 978-3-11-026028-1' is available (http://www.degruyter.com/view/product/177487);
- **Value chains corresponding to different scenarios of biorefineries** integrating results and concepts developed in EuroBioRef were designed and multidimensionaly assessed to realize demonstrations of the developed technologies, but also to test scenarios of industrial exploitation;
- On 11-12 February 2014, we successfully organized a two-days conference '**Tomorrow's Biorefineries in Europe**' in Brussels with our sister projects, namely Biocore and Suprabio, notably to present our results and propose our technologies to stakeholders (https://colloque.inra.fr/eubiorefineryprojectsfinalconf);
- **A European Master on Biorefineries** has been designed and will be launched in 2015.

Final results, intentions for use and impact

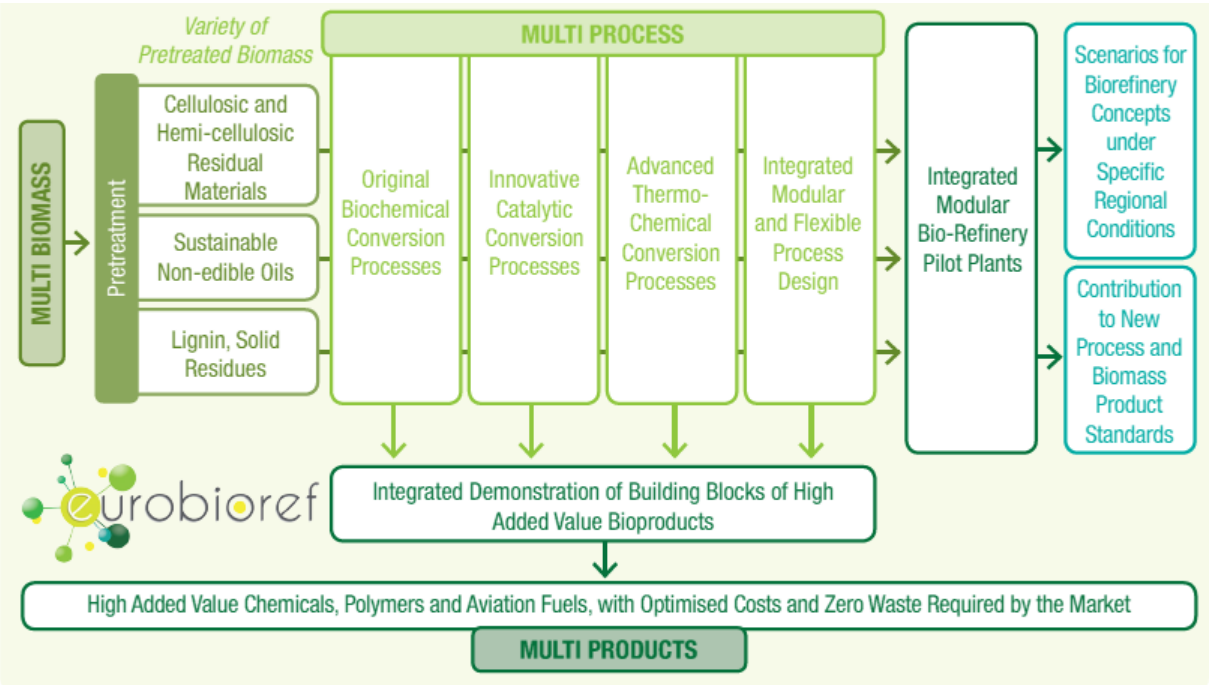
This project generated scientific innovation, technical advancements, and business opportunities. The elaboration of delocalized and virtually integrated biorefineries will enable creation of specialized jobs in rural areas, thus reboosting local economies in the whole territory of the EU. An exploitation plan has been designed, and we assessed the number of jobs that will be created/saved in Europe (a few thousands along the VCs, including indirect jobs)

I.2. Context and project objectives

Context

The development and implementation of biorefinery processes is of the upmost importance to meet the vision towards a sustainable economy based on bio-resources, namely, the so-called 'bioeconomy'. Contrary to petro-resources of which the nature and composition variations are 'relatively' limited, under the term 'bio-resource' or 'biomass' are gathered compounds of very different natures, namely cellulose, hemicellulose, oils, lignin, etc. Thus, a complete set of specific technologies must be developed in order to convert each fraction as smart as possible. This implies, among others, the elaboration of a lot of (bio-)chemical and thermochemical transformations, which constitute core technologies that have to be developed and implemented in a global sustainable framework along the whole valued chain.

Within this context, the EuroBioRef project (*European Multilevel Integrated Biorefinery Design for Sustainable Biomass Processing*; www.eurobioref.org) was a 4 years program coordinated by CNRS, France, launched on March 1st, 2010, and closed on February 28th. It was supported by a 23 M€ grant from the European Union 7th Framework Program (FP7). EuroBioRef had this unique feature of dealing with the entire process of transformation of biomass, from non-edible crops production to final commercial products. It involved 29 partners (industry, SMEs, academics) from 15 different countries in a highly collaborative network, including crop production, biomass pre-treatment, fermentation and enzymatic processes, catalytic processes, thermochemical processes, assessed by a life cycle analysis and an economic evaluation of the whole development chain. With this strategy to develop next generation biorefineries, the project generated a lot of results, with an important impact on the European bioeconomy, including new energy & new chemicals production strategies.



Flexibility, adaptability and multidimensional integration of the EuroBioRef Project.

Objectives

EuroBioRef then intended – and succeeded – to propose a new highly integrated, diversified and sustainable concept, which involves all the biomass sector stakeholders. The potential of all the fractions issued from the various types of biomass is used to yield a value-added as high as possible in a sustainable and economical way. The overall efficiency of this approach is a vast improvement to the existing situation and considers options such as: Production and use of a high diversity of sustainable biomass adapted for European regions / Production and use of high specific energy bio-aviation fuels (42 MJ/kg) / Production of multiple products (chemicals, polymers, materials) in a flexible and optimized way that takes advantage of the differences in biomass components and intermediates / Improvement of the cost efficiency through improved reaction and separation effectiveness, reduced

capital investments, improved plant and feedstock flexibility and reduction of production time and logistics / Reduction of the required energy / Zero waste production and reduction of feedstock consumption.

Intentions for use and impact

The project then defined results expected in terms of:

1) Business

- Demonstration of the economic and technical performance of biobased products including bio-aviation fuels and chemicals;
- Demonstration of the increase in economical performance due to use of second-generation feedstock by using the whole plant in a zero waste concept;
- Demonstration of the sustainable value chain of non-food crops cultivated in synergy with food-crops, through rotation strategies that will benefit to both food and non-food crops yields;
- Definition of final products specifications and tests of new products to be able to propose them directly to customers.

2) Scientific innovation

- Methods for conceptual process design widely applied in the chemical sector towards bio-/chemical applications;
- Heterogeneous, homogeneous and enzymatic catalytic systems including fermentation and optimization of the formulations taking into account the purity of the feedstock;
- New low energy separation techniques and adaptation to biomass-derived products, which will enable lowering of the overall cost;
- New reactor technologies for minimizing production of by-products while enabling substantial energy savings;
- Co-products reutilization technologies in order to further increase attractivity of the process;
- Integrated reaction/separation technologies for optimized process design;
- Development of new purification technologies of fermentation broth using green solvents, which will further improve the overall sustainability extent.

3) Technical advancement

- Crop rotations optimization for Northern/Southern Europe and Africa, selection of appropriate sustainable biomass feedstock for diverse EU environments;
- Rationalization of the chain elaborated to yield each product and global integration/optimization of the whole process;
- Quality control of a variety of feedstock for a variety of end-products to set high level standards;
- Demonstration at the lab/bench scale of sub-units and demonstration at the pilot scale of integrated chains for significant products;
- Integration of several reaction and separation steps for high selectivity and conversion, energy and Capital (CAPEX) reduction.

4) Sustainability assessment and performances

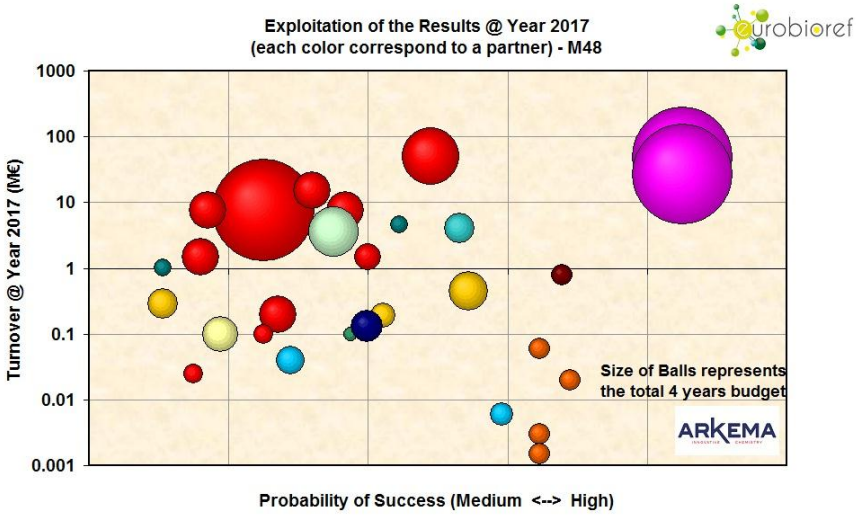
- Specific logistic methodology for cultures in Northern and Southern Europe;
- LCA methodology for evaluation of environmental performances;
- Economic modelling for assessment of economic viability;
- Sustainable assessment of the whole chain for economics.

5) Socio-economic impact and societal implications of the project

- Creation of specialized jobs in rural areas; The investigated value chains could contribute to about 100 to 200 direct jobs, and up to 3600 jobs when taking into account the indirect jobs corresponding to each implementation;
- Developing business/side businesses in local economies.

6) Preparation of the Exploitation Plan of the project (Figure hereafter)

EuroBioRef prepared its exploitation plan taking into account sales from each partner in 2017 and at mature market, and self-assessing a probability of success. The workplan was accordingly adjusted in order to increase the chances to reach the market and to cross the “Valley of Death”.



Exploitation of the results @ Year 2017 (each color corresponds to a partner) – Results at M48, End of the Project.

I.3. Main S&T results/foregrounds

A project that has been closely followed by the EC, with an excellent appreciation

"EuroBioRef – How a radical re-design is strengthening economic viability in the bioeconomy". *"For most people, the bioeconomy is the way of the future. A shift towards an economy based on renewable resources not on fossil fuels is no longer just an option, it's a necessity."*

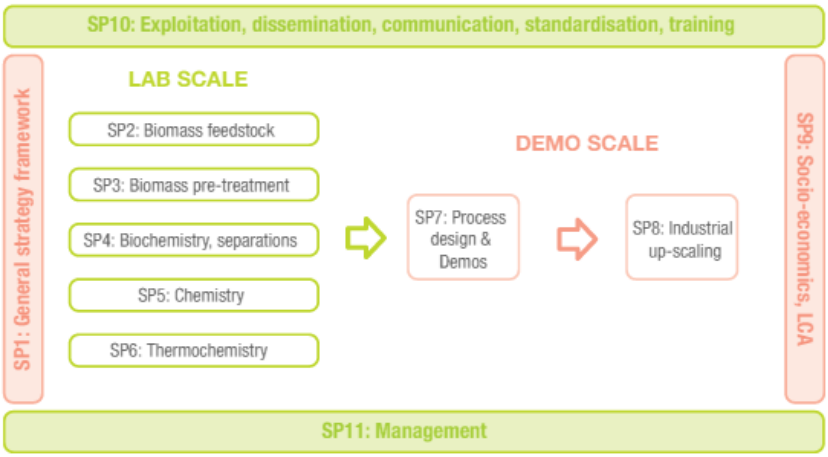
View the article online:
http://ec.europa.eu/research/infocentre/article_en.cfm?item=Result%20of%20search&id=/research/star/index_en.cfm?p=ss-eurobioref&calledby=infocentre&artid=25553

Results booklet

A *ca.* 70 pages public booklet giving an all-comprehensive and full scope of the results of the project can be, as aforementioned, downloaded from our Website (www.eurobioref.org). This section is, so to speak, a summary of this booklet.

I.3.1. OVERVIEW OF THE S&T RESULTS OF THE PROJECT

The project was initially configurated along scientific&technological fields (represented by SubProjects, 'SPs', see the figure hereafter). After two years, the findings were integrated into 'Value Chains' in which the findings and the developed technologies were integrated. We then give here the main S&T results of the projects in terms of the various fields involved in a biorefinery, before giving an overview of the value chains. Then, a summary of the main large-scale demonstration results is given.

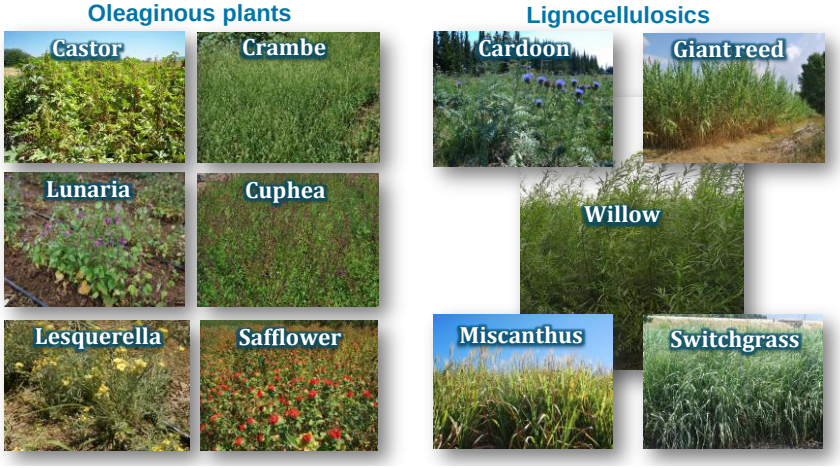


EuroBioRef scientific, technical, technological & methodological fields represented by sub-projects (SPs).

Note that the project ended on a very positive note since most of our objectives have been reached, even including new demonstrations. The organisation of the project through value chains rather than through expertise (SPs) has proved to be much more efficient. This should be a key teaching for any other EU project, although discussions through expertise domains generated in SPs are also needed to smoothly run a project. A Matrix organization should be promoted and more time allocated to discussions throughout the project. This is a key element in this new field of biorefineries, in which we assembled various competences that never met before, and thus specialists from different fields got acquainted to know each other, generating a fantastic synergistic effect.

I.3.1.1. Results of the project by Scientific/Technical fields

Biomass supply.



Main plants cultivated in the EuroBioRef project.

1) Oil crops. We identified the suitable areas for cultivation of safflower, crambe and castor in Europe. Castor and safflower are the best-suited plants to be grown in the Mediterranean agro-climatic zone, compared to the rest of the oil crops studied in this project. They satisfactorily grew and produced considerably high seed yields. Especially, castor produced similar yields to the locally grown sunflower. In Poland, representing the continental agro-climatic zone, safflower was proved to be unsuitable for cultivation, whereas crambe and camelina performed the best. Crambe plants were sown in a commercial size plantation (10 ha) with very good establishment and seed production, and the plantation was harvested with existing commercial machinery. In Madagascar, yields evaluation showed an average result that can be significantly improved. The weeding and the sowing before the 30th of December are essential to increase the castor oil plant productivity. Fusilade appears to eradicate the prevailing weeds, while mechanic weeding is still being tested. The density should be increased to 80x60 in order to improve the leaf covering of the soil and to avoid the weed growth. This can also contribute to increase the yields. The contribution of the new varieties can ultimately improve the productivity. We elaborated a guide of good practices for the farmers to enable efficient growing castor oil plant in Madagascar, which presents interesting perspectives of revenues provided by this new cultivation and should strongly motivate farmers to initiate this new lucrative activity.

Concerning more 'prospective' crops, namely cuphea, lesquerella and lunaria, we still need experimentation on agronomic methods and plant breeding to improve crop characteristics in order to enable their industrial exploitation. The major constraint to the development of cuphea for industrial uses, apart from its frost sensitiveness, sequential maturation and release of seeds from seed pots, is the seed shattering, stickiness and dormancy, which are at present being studied by plant breeders. Thus, the highest priority to ensure maximum seed yields is the genetic and plant breeding research to obtain determinate flowering and non-shattering cultivars. Lesquerella is still under experimentation, as it is a desert crop not likely to be grown in many parts of the world. At the present time, lesquerella seed is not sold on any market and genetic and breeding efforts are focused on the faster growing of the crop – which is perennial, but grown as annual in southern USA –, and on the improvement of its yielding capacity. Lunaria is also at the development stage. Its mechanical harvesting and the cleaning of the seeds are some issues, but the major limitation is the biennial nature of the plant and its high vernalisation requirement. The production potential and agronomy of the crop further require investigation, as the crop often does not thrive in large open fields. Thus, at present, commercial production of lunaria is limited to seed multiplication for ornamentals.

2) Lignocellulosic biomass. Similarly to oil plants, the European potential for cultivation was thoroughly assessed. It is estimated that cardoon and giant reed could be grown in France, Greece, Italy, Spain, Portugal, although there is evidence that the latter could be even expanded in Northern European countries. Switchgrass is recommended for France, Germany, UK, Bulgaria, Ireland, Netherlands and Denmark, whereas it seems possible to grow miscanthus in the majority of the European countries apart from the Mediterranean and Nemoral zones. Willow can grow in colder climates in Finland, Sweden, Poland, Latvia, Lithuania, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Germany, Hungary, Romania, Denmark, Ireland, Netherlands and UK.

Information on the harvesting (time & equipment) and storage operations for the harvested materials, as well as on their handling requirements have been collected, and data were populated in the logistics tool (see point 3 - Logistics below). Specific harvesting and storage trials have been performed for willow to assess the quality of biomass with several storage methods.

3) Logistics. A comprehensive tool for optimizing biomass logistics has been developed in the previous reporting period. This new tool can handle multiple feedstock/source input into the supply chains as well as multiple outputs for the biorefinery (or other consumer of biomass), and takes into account losses throughout the supply chains, including losses during storage (depending on duration of storage). The results can be given as optimization of the total costs or energy consumption or CO_2-emissions, or any weighed combination of these 3 parameters. During this last period, the tool was enriched with more data sheets and logistic chains, and provided further input to the value chains. More than 250 data sheets were elaborated, which describe all the handling elements for crops such as willow, castor, safflower, crambe, or giant reed. Any crop or biomass product can be included in the model and 15 (or more) handling elements can be included in each supply chain.

Although the rest of the tasks were already officially completed, we benefited of this final year of the project to continue with our small field trials with the oil crops and the crop rotation strategies.

Primary biorefinery: Biomass pretreatment.

1) Lignocellulose. Evaluation of enzymatic hydrolysis pilot trials (based on the BALI technology developed within EuroBioRef), and subsequent investigation in lab scale have given additional information on how to run and modify the pilot plant in order to achieve optimal yields. Indeed, some discrepancies were detected between lab and pilot experiments. The reasons for these differences are of various origins, such as pH fluctuations, effect of citrate buffer and bacterial contamination. It was concluded that several changes in the design and the operating mode of the pilot plant need to be implemented in order to get better results in the pilot plant. After implementation of the relevant modifications, a massive decrease in enzyme consumption in the pilot plant was observed, which underlined the efficiency of our approach.

Early evaluation of the lignin by-product indicated that a slight difference was also observed between the samples produced in the lab and in the pilot plant. This difference can most probably be explained by condensation during storage. Here also, the study indicated that the scale up was successful, but that the operating procedures needed to be modified. To this respect, the properties of a second campaign displayed a significant improvement compared to the first, which shows that we were able to efficiently tackle upscaling issues.

2) Oil crops. Lunaria, castor and crambe oils were successively refined by Novance. Their content in fatty acids falls in the expected range compared to the corresponding commercial oils. Especially, 60 L of crambe oil were refined and saponified. The content in erucic acid falls in the expected range for commercial crambe oil. The isolation of erucic acid by distillation was finally performed.

In parallel to this work, a new clean process for enzymatic hydrolysis of vegetable oil was fully set up at the prototype scale, enabling environmental benefits.

Towards secondary biorefinery: Biotechs.

1) 3-HPA. Characterization of a second generation *3*-hydroxypropionic acid production strain has been completed. Despite the fact that the strain is growing well on biomass hydrolysate, it has not been possible to get sufficiently high fermentation yields of 3-HPA to enable an economically feasible process. Thus, the value chain based on 3-HPA has been abandoned and the related work has been terminated.

2) *n*-butanol and *1,3*-propanediol. We found that the production of *n*-butanol from biomass hydrolysate using an adapted strain of *C.pasteurianum* is low if glycerol is not present in the fermentation medium. Mixed medium (hydrolysate:glycerol) fermentations have been run at a 2 m^3 pilot scale giving culture broth, giving a mixture of *n*-butanol and 1,3-PDO, with very high yields compared to the state-of-this art. A similar mixed product can be obtained using glycerine as a sole

carbon source. Efficient separation of the 2 products by gas stripping has been demonstrated. Raw and pure glycerine give comparable results when a Clostridium consortium is used in unsterile pilot fermentations. A minor drop in 1,3-PDO titer (15%) is observed when raw rather than pure glycerine is used with *L.reuteri* as a production organism. When spruce hydrolysate is used as a carbon source, 1,3-PDO production is dramatically reduced. Addition of cobalt to the fermentation medium is beneficial, supposedly due to improved vitamin B-12 synthesis in *L.reuteri.* As a conclusion, the development of industrial strains and corresponding production processes has been successfully carried out. Investigations of different separation technologies were also performed, with gas-stripping and ionic liquid use being the most promising candidates. Especially, separation of the 2 products by gas stripping has been demonstrated. In such cultures, it is important to avoid glucose limitation since the product formation stops as soon as glucose runs out. Acid accumulation to > 23 g is inhibiting the process.

All the tasks proceeded accordingly to the initial schedule. Transfer from lab scale to the pilot scale was successful for *n*-butanol and 1,3-PDO production with *Clostridia spec.* The obtained very high yields together with the concept of dual efficient separation of the two-aforementionned target products motivated the consortium to file a patent on the subject.

3) Biogas. Biogas production from residual materials of oil plant processing using thermophilic consortium was developed. It was shown that an adaptation of the biogas consortium on the new substrate has taken place. The high lignin content of the seed cake (55%) significantly limited the biogas production and a value of 380-400 L/kg oTS was obtained compared to 700 L/kg oTS using cellulose as a substrate. These values were obtained in continuous biogas culture at a loading rate of 1.5 g oTS/L*day and a residence time of 25 days. In order to increase the loading rate in continuous culture, two different biogas reactors were tested and a gradual increase in the loading rate was performed either in mono-substrate fermentation with seed cake, or using a co-substrate with cow manure. The loading rate was increased to 3.5 g oTS/L*day, and the residence time was lowered to 9 days. Compared to the biogas reactor with oil seed cake taken as a mono-substrate, no significant increase in the specific biogas production rate was observed in the co-substrate fermentation with cow manure. However, the elevated levels of volatile fatty acids indicate an unstable reactor performance in the biogas reactor without cow manure. On the other hand, ammonium accumulation and elevated pH values were detected in the reactor with cow manure as a co-substrate. The effect of trace elements was then tested on the reactor with mono-substrate fermentation with castor oil seed cake. The addition of commercial trace elements recipes (methanomix – Ferrosorp – HeGo Biotec GmbH) gave a better reactor performance, and the amount of volatile fatty acids significantly decreased compared to the reactor without trace elements addition. However, the maximum loading rate did not exceed 4 g oTS/L*day at a residence time of 9 days. The negative effect of ricin, a component present in the castor oil seed cake, may explain the failure to run the biogas reactor at higher loading rates. Pilot plant tests to produce biogas from castor cake were finally performed at BKW.

Secondary biorefinery: Advanced processing by Chemistry.

A huge amount of results was obtained, as chemical technologies constitute the core of the project - together with thermochemistry presented in a next paragraph. During the period, the screening phase for catalytic transformations was obviously completed. SP7 and SP8 chemical demonstrations have then been performed, based on technologies developed in SP5 (& SP6 for thermochemistry). Hereafter, for sake of clarity, we sorted the main SP5 results by WP:

WP5.1. Concerning **nitriles** production, CNRS-IRCELYON completed the work about the continuous transformation of fatty esters in the gas phase. The effect of temperature reduction is now better understood, and a patent application has been filed. Concerning then **metathesis**, the work at CNRS-RENNES on new catalysts synthesis is not successful while a new method by fluorimetry was set up to determine the peroxides content in the feedstocks. It is also confirmed that oleonitrile is less efficient than methyl oleate in the butenolysis reaction, and the TON remains low in both cases (note that a successful SP8 demo on butenolysis has been performed). Note that **WP5.1** was very productive with a lot of interactions between partners. The developed thermal cleavage technology, which enables 30% energy savings, is part of **VC1**, and the demonstration was achieved at the pilot scale. Metathesis and oxidative cleavage are key technologies both for **VC1** and **VC2**, and were also demonstrated at the pilot scale. It is confirmed that this WP gives some attractive opportunities for high value polyamides, and the first monomers samples were prepared by hydrogenation. Some of the co-products were identified as road fuels candidates, with a positive assessment by DTI in SP7 for three of them.

WP5.2. About **acetals**, FEUP completed the study about the SMBR process. Samples of GEA and DBE were prepared and evaluated in aviation fuel, but the products have not been selected by OBRPR. TUDO completed the simulation study about the catalytic distillation process to make long chain glycerol acetals. The advantage of the reactive distillation concept has been shown, enabling higher conversions than the estimated chemical equilibrium. As a general matter, direct oxidation, SMBR and catalytic distillation were identified as promising processes to substitute a conventional batch process by a continuous process for large volumes applications. The integration of acetals compounds was evaluated in **VC6**. A demonstration of the POM process was finally made in SP8 with the aim of using the product as a diesel fuel.

WP5.3. As for **glycerol valorization**, CIRCC optimized the *1,3*-propanediol conversion to TMC. The yield is so far limited to 80% by an equilibrium reaction.

WP5.4. This WP was completed since M36, and was at the core of the **VC3** aviation fuel value chain with the Guerbet reaction.

WP5.5. In the conversion of **3HPA to butyl acrylate**, TUDO completed the simulation study about optimization of the esterification process by reactive distillation of acrylic acid and butanol. Taking into account the impurities profile of acrylic acid and biobutanol, several options were proposed to reach the required purity of butyl acrylate. **WP5.5** was fully integrated in **VC4,** which was finally abandoned due to the 3HPA availability issue. The simulation of the new reactive distillation process for the esterification step was completed, and a demonstration was made at the pilot scale from fossil acrylic acid and biobutanol.

WP5.6. For the synthesis of **maleic anhydride** (MA), CIRCC tested the one-pot process with biobutanol from Cathay. The MA yield decreased while the PA (phtalic anhydride) yield was increased compared to experiments with chemical butanol. The results are in line with those obtained in the lab with chemical butanol (43% yield of MA + 5% yield of PA). Tests on the co-feeding options butanol/*o*-xylene failed. Then, scale up of the one-pot process was demonstrated at the pilot scale by Orgachim. Maleic anhydride is a very good example for **VC6** of potential integration in existing units (phthalic or maleic anhydride units).

WP5.7. About **sugar hydrogenation**, SINTEF optimized the catalyst (Pd/alumina) and the conditions for Guerbet alcohols hydrogenation to alkanes. Reducing the palladium content (1%), good conversions (> 90%) of *2*-ethylhexanol were obtained leading to the corresponding alkane or alkene depending on the contact time. Accordingly, this WP was finally focused on Guerbet alcohols hydrogenation to alkanes for **VC3** to aviation fuels. Some catalysts prepared in the lab were identified to reach the target. The scale up was successfully achieved by OBRPR, but with a different catalyst due to supply issues.

Secondary biorefinery: Advanced processing by Thermochemistry.

We gained significant scientific knowledge in the synthesis of higher alcohols synthesis from syngas. The ambitious target initially set was a space-time-yield (STY) of 200 gC2+OH/kgcat.h with a reference yield of 5 gC2+OH/kgcat.h. The developed catalysts reached 35% of the target and improved the reference state-of-the-art yield. CNRS-UCCS developed Fe-Cu catalysts prepared by precipitation and impregnation with high activity in CO conversion. A few catalysts showed in a single pass.a space-time yield of 60 gC2+OH/kgcat.h at 20 bar Depending on chemical composition, the catalysts also produce either methanol or hydrocarbons. The developed copper-iron catalysts showed stability in laboratory tests in the presence of several ppm of sulfur in biosyngas.The K/Ni-/Mo2C catalyst developed in CERTH exhibited the highest space-time yield (70 gC2+OH/kgcat.h) at 60 bar. It is expected that the yield can be further enhanced by optimizing the reaction conditions such as unreacted gas recycling, pressure, H2/CO ratio. Still, further improvement of the system is needed for industrial application focusing on fine tuning the catalytic active sites for maximizing selectivity to the desired products. For industrial applications, we further showed that the specifications for gas cleanliness for the catalytic processes can be achieved through a combination of commercially available technologies and of in-house novel methods – especially for the scavenging of tar species.

Further, the analyses of the various activated carbons produced from each selected biomass were finalised. In total, 30 physically activated and 88 chemically activated carbons have been produced at CERTH from a variety of biomasses. The 4 best performing carbons issued from physical activation and the best 8 carbons issued from chemical activation were sent to CECA for additional analysis, after SEM analysis carried out at CERTH. CECA then measured adsorption Indexes, BET specific surface areas, which are, in some case extremely high, and evaluated DFT pore size distributions. In some cases, cation and hardness analysis were also performed. Applicative tests were also performed. Activated carbons produced by CECA and CERTH were tested for cleaning amino acids,

saccharose syrup, glycerine and lactose (customer-driven applications). Batch as well as column purification treatments using a newly developed “mini-column test” were performed. Some carbons already used at the industrial scale were also tested for benchmarking. Efficiency comparison of EuroBioRef Carbons *vs.* Commercial Carbons allowed us to determine Product value and Market opportunities. Except for the lactose application, there is always at least one activated carbon from EuroBioRef working better than the carbon currently in use. To be able to convince customers to consider those carbons for industrial utilization, we will have to show them that these carbons will be available shortly in industrial quantities and at competitive prices. This will pretty much depend on the availability and cost of the corresponding biomasses.

As a global assessment, the best candidates for the production of 100 g of activated carbon by CERTH are **Miscanthus** and **Safflower Shell**, while for CERTH it was decided to proceed with the production of 100 g of activated carbon employing KOH chemical activation using **Miscanthus**, **Sunflower** or **Switchgrass** as feedstocks.

LCA.

LCA was fully addressed. Especially, from an LCA perspective, the water issue is essential and deserves a very special attention. In EuroBioRef, the water issue was addressed by means of the “water withdrawal” indicator, which is a measure of the water withdrawn from the environment, regardless of its fate after withdrawal. Based on the latest developments in terms of water footprinting, another relevant indicator is the so-called freshwater consumption (which can be weighted or not based on regional water scarcity). The latter actually is focusing on the actual quantity of water, which is withdrawn but not returned in the same watershed, *e.g.*, incorporated in the product or evaporated. In light of the latest developments (in particular, the very recent approval of the new ISO standard on Water footprint / ISO 14046, not yet published), freshwater consumption could prove to be a more accurate (or complementary) measure of the stress on water resources. Just like GHG emissions, water use should be considered as a key indicator when considering the sustainability of bio-based systems. In particular, the irrigation during cultivation will usually play a significant role, just like the use of water in industrial processes (*incl.* process and cooling water). In the frame of developing a bioeconomy in Europe, the consideration of freshwater consumption in compliance with the latest ISO standard (possibly weighted based on regional water scarcity) should be considered as one of the key indicators to measure the performance of bio-based systems, together with other key indicators such as GHG emissions and the consumption of non-renewable energy/mineral resources.

I.3.1.2. Results of the projects put in perspective in the Value Chains

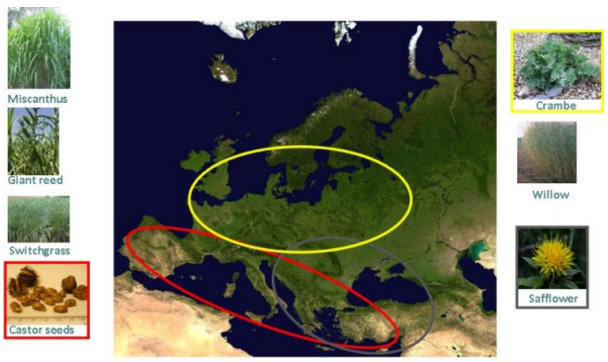
Value chains corresponding to different scenarios of biorefineries integrating results and concepts developed in EuroBioRef have been designed, and were multidimensionaly assessed, to realize demonstrations of the developed technologies, but also to test scenarios of industrial exploitation. The assessment of the 6 value chains (VCs), which were generated at the end of 2nd reporting period, was polished up:

Value Chain 1: Castor oil to polymers;
Value Chain 2: Crambe/Safflower oils to polymers;
Value Chain 3: Alcohols to fuels (ATF);
Value Chain 4: Lignocellulosics to acrylates *(abandonned due to low technologicaladvancement)*
Value Chain 5: Syngas-based products;
Value Chain 6: Integrated productions in existing assets.

The description and main outputs of the value chains are as follows:

Value Chains 1 & 2. Both value chains are dealing with vegetable oils and are technologically the most advanced ones. The purpose of VC1 is to start from castor and produce a high value monomer with some co-products being used as fuel. VC2 starts with oleaginous crops (crambe, safflower) producing high value monomers and short fatty acids, suitable for fuel application once esterified. VC1

Castor processing unit.



Potential locations for non-edible crops new cultures in Europe.

and VC2 have several steps in common. Both these VCs have the possibility to start from castor, crambe and safflower. Further, a route was proposed for castor oil (VC1), and combines it with the chemistry of VC2 to deliver monomers even more interesting than those initially planed in VC2. Then, due to similarities and common outputs, these VCs were merged.

Pilot for chemical reactions.

Value Chain 3 & 5: Fuels and syngas-derived products. These VCs relate to the production of "ATF" used for aviation fuels (VC3) and to the conversion of black liquor to syngas-derived products (VC5) including alcohols. Then, VC3 is closely related with VC5 as both share the same route of syngas production *via* gasification and its consecutive conversion to alcohols. However, VC3 also considers another way of production of heavy alcohols/branched paraffins *via* advanced chemical routes to be blended as components of aviation gasoline and jet fuel.

Willow chips loading.

Value Chain 4: Biobased acrylates. This Value chain deals with conversion of lignocellulosic crops to hydrolysates, fermentation to *3*-hydroxypropionic acid, then dehydration to acrylic acid, and in parallel fermentation of sugar hydrolysates and glycerol to *n*-butanol. Due to lack of technological maturity / economical viability, it was decided to drop the demonstration of this VC and to redistribute some useful competencies in the other VCs.

Test engine.

Value Chain 6: Integration of EuroBioRef technologies in existing assets. VC6 offers a framework to consider EuroBioRef chemistries and technologies as additions to existing, preferably European plants. Several such "co-location" scenarios have been proposed as modifications of VCs 1 to 4, VC5 being a co-location model by itself. On the other hand, 11 co-location models have been identified for EuroBioRef conversions, which were not studied in any of the other VCs. The work was re-focused on the most promising VCs. With the addition of the 2 products coming from VC4, VC6 demonstrated in which cases it makes sense to add a biobased production in an existing asset (plant) and capitalize on skilled personnel, available infrastructure, and plant integration. In this case, the Integrated Biorefinery is looking at the integration of a biobased product in a fossil (or bio) existing asset.

Higher alcohols production unit.

Lignocellulosics fractionation unit.

I.3.1.3. Overview of the main industrial demonstrations

Many large-scale demonstrations could be achieved during the project, with a lot of technologies thus brought to TRLs > 5. Hereafter are reported main examples of successes:

Agronomics. In large test fields, we confirmed the agronomic interest and the performance of willow species and giant reed for lignocellulosic biomass, and castor (TRL = 7 to 8) as well as safffower and crambe (TRL = 5 to 7) for oil plants. Further, the results obtained since 2010 by SOABE has allowed the establishment of a handbook for carrying out the castor oil plant cultivation in Madagascar. We consider our yield estimation method as reliable, and the yields as correct regarding the fact that the soil has never been cultivated before. Then, **castor production in Madagascar is now "en route" to commercialization** and should start sampling first customers for validation soon after the end of the project (TRL = 8).

Biomass primary processing. The scale up with the continuous reactor BALI pilot plant for fractionation/hydrolysis of lignocellulosics was successful, with a **full-scale unit planned for 2017**. For willow, after the third batch of enzymatic hydrolysis, 80% conversion was achieved after 48 h with an actual enzyme loading of 40% w/w. Further, for castor, the function of a specifically designed and constructed dehulling unit was validated, together with that of an oil extraction pilot.

Industrial production of acetals. The POM-M process was successfully scaled up in a 1600 L pilot reactor at Pierre-Bénite, France. A 950 kg sample was then prepared in one batch, and a 60 kg of sample were provided to DTI for diesel fuel tests. The process is now validated.

Industrial fatty nitrile production. The synthesis of a mixture of mono-unsaturated stearonitrile from *12*-hydroxystearic acid is a key step in VC2 for oxidative cleavage. We can use standard industrial equipment and the yield is rather high. The industrial feasibility of mono unsaturated stearonitrile (isooleic nitrile) from *12*-hydroxystearic acid has been demonstrated at the pilot scale.

Industrial short ester production. *i)* The scale up of the cross-metathesis reaction between methyl undecenoate and acrylonitrile was successfully demonstrated at a 100 liters scale. This is a new opportunity to get high value monomers from castor with the metathesis technology; *ii)* We have demonstrated the butenolysis reaction directly on a high oleic vegetable oil at a 60 liters scale. Good results were obtained with a TON above 50.000 that was the target of the project for metathesis. This is a way to get valuable short chains esters from a European biomass; *iii)* Thermal cleavage of castor oil methyl ester to heptanal and methyl *10*-undecenoate was piloted in a continuous pilot plant, and > 30% energy reduction were obtained, while keeping the same high selectivity and conversion. A 15 kg pilot lot was produced; *iv)* Oxidative cleavage of unsaturated fatty nitriles with hydrogen peroxide was shown to operate with good yields at the pilot plant scale. The lab-results were scaled-up without any major issue.

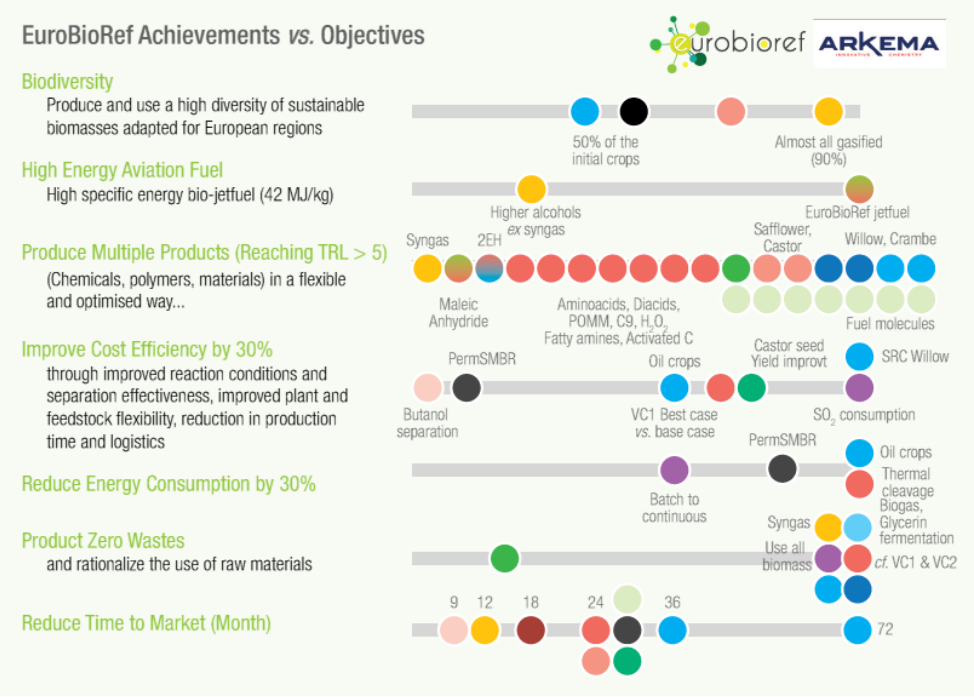
Guerbet alcohols. 210 kg of distilled bio-sourced 2-ethyl hexanol produced by Novance from bio-butanol obtained from Cathay Biotech and according to an optimized protocol at the agreed quality were sent to OBRPR for aviation fuels blending. A certificate of the renewable carbon content in this product, using a 14C-based method for the determination of the biomass content, was delivered.

I.3.2. SELECTION OF SIGNIFICANT OUTCOMES

Among all the results of the project, we describe here the most significant outcomes. In a first part, we highlight three major benefits to society that can be derived from this project, before giving the five most relevant industrial outcomes followed by the five most relevant academic outcomes.

I.3.2.1. Three major benefits to the society

1. ***Towards a sustainable bioeconomy.*** By achieving its ambitous objectives, EuroBioRef is a clear contribution to the realization of a new bioeconomy, *e.g.*, promoting biodiversity, reducing energy consumption, producting zero wastes, etc. (see the graph below).



2. ***Creation/Saving of jobs***. The number of jobs created upon the implementation of the value chains was assessed, in terms of **direct and indirect jobs**. The direct jobs are created in the

production units. The number of indirect jobs was evaluated using correlations obtained in the core sector of activity (chemistry). On top of the creation of jobs along VCs 1, 2, 3 & 5, the VC6 implementation gives **nice examples of ways for preserving jobs in Europe**. Indeed, VC6 considers the use of already existing units to redynamise fading activities by proposing the production of value-added bioproducts. This has the considerable advantage of necessitating a low CAPEX (by revamping/modyfing alreading existing infrastructures), thus making the European option attractive compared to the option of constructing a new unit elsewhere from scratch.

As a whole, the investigated value chains could contribute to about 100 to 200 direct jobs, and up to 3600 jobs when taking into account the indirect jobs and farming jobs corresponding to each implementation.

3. ***Towards a better life quality.*** The developments in EuroBioRef were carefly examined through a new dedicated LCA methodology, which guided us to design value chains socio-(economically) attractive. The considered parameters were climate change, resources, water withdrawal, ecosystem quality and human health. The value chains were designed to optimize these parameters, with excellent results. **Further, we are now on the process of standardization of a new aviation fuel comprising a EuroBioRef biocomponent, with less environmental impact, which is a new area for EU.**

I.3.2.2. Five main industrial outcomes

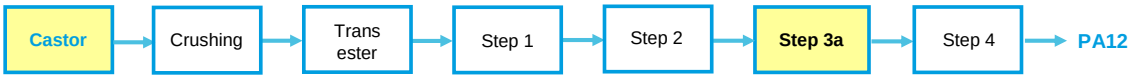
1- Biobased PA12 polymer based on castor oil (VC1) - ARKEMA, BKW, CECA, CNRS-IRCELYON, CNRS-RENNES, CNRS-UCCS, CRES, DTI, IMPERIAL, PDC, QUANTIS, SOABE, TUDO, TUHH, UMICORE

A complete value chain is designed to go from castor to the high value polyamide 12 (PA12).

20 ha castor field in Madagascar.

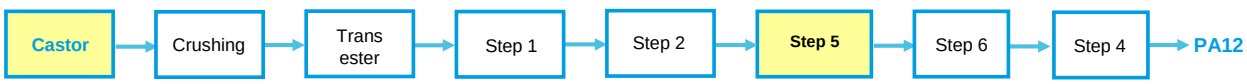
EuroBioRef PA12 sample.

❖ **Chemistry A : Metathesis** – Base case



❖ **Chemistry B : Metathesis** – Best case → Less steps=Lower CAPEX

❖ **Chemistry C : Hydroformylation** → High TurnOver Numbers



❖ **Chemistry D : Oxidative cleavage** → No expensive catalyst

The key issues for the castor cultivation in Europe and Madagascar were identified and a crop rotation strategy with food crops such as corn or leguminous plants was studied. Preliminary results about the crop rotation strategy are promising showing that we could expect savings in terms of fertilizers, pesticides and herbicides along with increased yields for both the castor and food crops. All the castor co-products (straw, meal, hull) can be valorised as fertilizers, activated carbon or biogas. The castor cultivation was demonstrated in Madagascar with field tests up to 20 ha (TRL = 8). The need for the Value Chain at mature market is estimated at **30.000 ha** of castor and **25.000 ton/year** of oil.

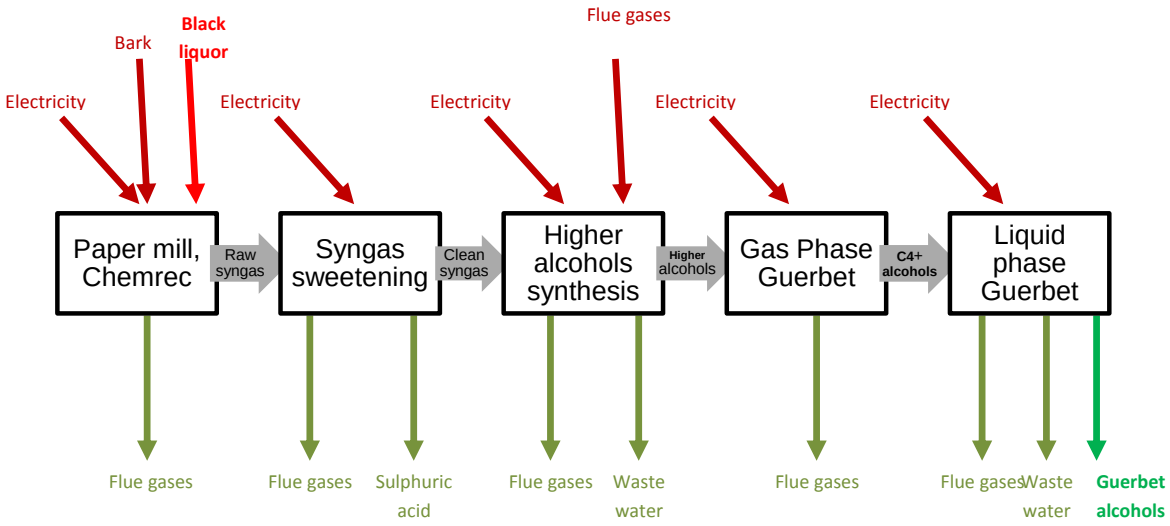
The final market is the long chains polyamides market with existing polymers such as PA11, PA12 and PA10,10. Global market is about 200.000 tons with 5% growth per year. PA12 is currently fossil-based from butadiene, while PA11 and PA10,10 are already castor-based. Long chains polyamides are high performance polymers in terms of flexibility, moisture resistance, stress cracking resistance and polar fluid resistance. The main applications are automotive (fuel lines, flexible pipes, air-brake tubing systems), energy (off shore pipes for oil recovery) and sport and leisure (shoes soles).

This Value Chain is a drop in solution making the bio-based version of an existing fossil-based polymer. The capital cost for the whole value chain is evaluated at **150 M€**. 200 direct jobs are expected in the plants along the value chain (all products and co-products), while total jobs including indirect jobs and jobs for the crop production would be between **1500 and 3000** depending on the location. More jobs would be created in case of castor production in Madagascar due to manual harvest.

Some individual chemical steps of the Value Chain were validated at pilot scale (up to TRL = 6) during the EuroBioRef project. Some issues have still to be solved, especially regarding some impurities in starting materials that impact the final application. Improvements are expected on the upstream part of the Value Chain, and the recommendation is to continue research and development programs improving the castor variety and adaptation to secure its cultivation in Europe. The stakes are to get homogeneous ripening of castor to make mechanical harvesting more efficient, to shorten the vegetative cycle to expand its cultivation for the European climate, and to reach better oil quality that would be more suitable for this chemistry.

Commercialization of PA12 could be expected in 2019 with 30% probability of success using the criteria set all along the project to assess a probability of success. Main barriers for the commercial development are currently the cost of castor production in Europe and the acceptation of this new crop in Europe.

2- Alcohols to Aviation Fuels (VC3) - CERTH, ARKEMA, PDC, IMPERIAL COLLEGE, QUANTIS, SINTEF, OBR, WKRZ, TUHH, DTI, UCCS-CNRS, BORREGAARD, NYKOMB, NOVANCE



Value Chain 3 targets the production of heavy alcohols, to be blended mostly as components in jet fuel. EuroBioRef project partners have developed processes to convert black liquor *via* gasification to aviation fuel components, based on higher alcohols. Operational testing has demonstrated the technical properties and operational viability of this process chain.

The black liquor undergoes gasification and the resulting syngas is then cleaned. This cleaned syngas is fed to the higher alcohol synthesis unit, which produces a mixture of C2+ alcohols. Alcohols with carbon chains lower than 4 are processed via the gas phase Guerbet reaction, while the C4+ fraction undergoes a liquid phase Guerbet reaction. The major product of the liquid phase Guerbet synthesis is 2-ethylhexanol, which can be blended in jet fuel. The potential for additional production of butanol synthesis from sugar hydrolysates in parallel to the syngas route has been addressed. However, this route was not fully assessed. Most of the process steps and the fuel reached a TRL of 6, eventhough the overall route is still limited by the least performing step at TRL = 4. The technology development was completed using conceptual process design, and cost and LCA analysis:

Biomass type and design volumes: The feedstock considered for the Value Chain is black liquor. The design capacity of the value chain is determined by the black liquor stream in a typical size paper mill: Black liquor processing capacity) = 2000 tonne dry solid/day.

Product type(s) and design volumes: The main product stream consists of branched C8+ alcohols with a capacity of 67000 t/year. An important marketable by-product derived from the syngas sweetening and further processing of sulfur compounds is 29900 t/year of sulfuric acid.

Capital required: The estimated capital cost is 440 Meuros. The step of Higher Alcohol synthesis contributes by 50% to this value.

Expect annual turnover and margin over annual expenditures: For the main product (higher alcohols for aviation fuels), the annual turnover is around 50 M€ (without green premium, and taking the product at its fuel value). Also considering the sales of the secondary product, sulfuric acid, the annual turnover increases slightly by 5 M€.

Expected permanent jobs created: It is estimated that 150 to 170 direct permanent jobs will be created. This number does include neither the jobs created during construction nor the jobs related to farmer businesses. Additional indirect jobs would also be created.

Next steps planned: Further development of the higher alcohol synthesis process step from TRL 4 to 6 through Horizon 2020 is planned. Especially, taking into account the teachings of the Life Cycle Analysis, (human health issues more specifically) and the high CAPEX for the process, new routes to make the final Guerbet Alcohols have to be investigated that would not require fossil or biomass energy, and would allow to decrease the CAPEX. Human health criteria are affected by the fact that the energy needed in the process is provided by wood combustion, which affects air quality.

It is worth balancing a little bit the conclusions above about human health. The major impacts with respect to human health are indeed associated with the combustion of wood needed to compensate the energy from black liquor combustion in the recovery boiler. When excluding this effect, the impacts of the biorefinery on human health are of the same order of magnitude (+10%, i.e., even below the level of uncertainty) compared to the conventional system (baseline), meaning that the biorefinery is only slightly worse than the baseline in terms of human health. On the other hand, it should not be forgotten that the biorefinery performs significantly better than the baseline in terms of greenhouse gas emissions and use of resources. When communicating to stakeholders on the environmental performance of VC3, it is essential to always keep in mind and specify the context of the assessment as well as the magnitude and nature of the limitations in order to avoid any misinterpretation.

Anticipated start-up year: It is expected that the full commercial development will be made possible by 2025, knowing that new routes have to be investigated. However, if key chemical steps could be validated for high value chemicals production, these steps could be implemented faster.

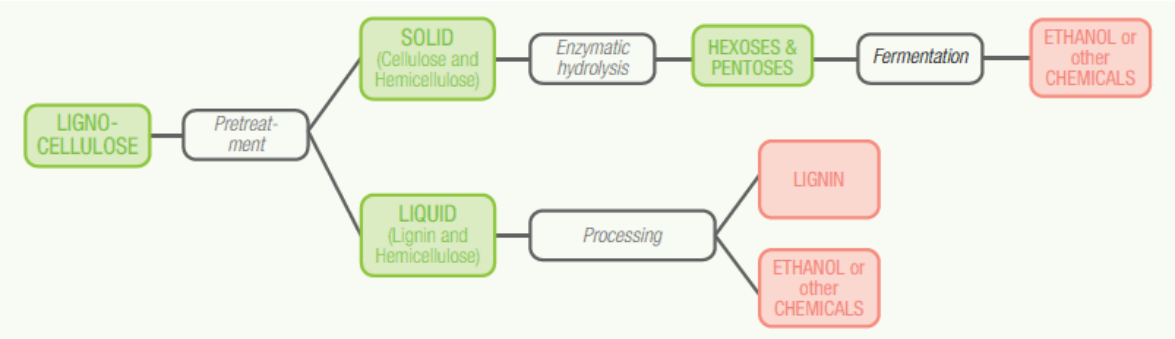
Identified barriers to commercial development: Cost analysis demonstrated that even considering the best-case scenario with marginal cost, the mean NPV (Net Present Value) remains negative. While there is a small (1%) chance of returning a positive NPV, this value chain still does not present a favourable investment opportunity. Costs are expected to decrease over time, as project learning and development lead to optimization of the involved processes. Possible direct routes to reduce current costs include the targeting of an end product of higher value, diversification of the end product mix or the assumption of premium payment (or product subsidy) for the current product. Production of a higher value product, priced at no less than 1035 €/t (for same product volume), results in a positive mean NPV. If the whole product pathway was directed to such a product (assuming all other process costs remain constant), this would result in the return of a mean NPV of nearly 115 M€, with nearly 80% probability of returning a positive NPV.

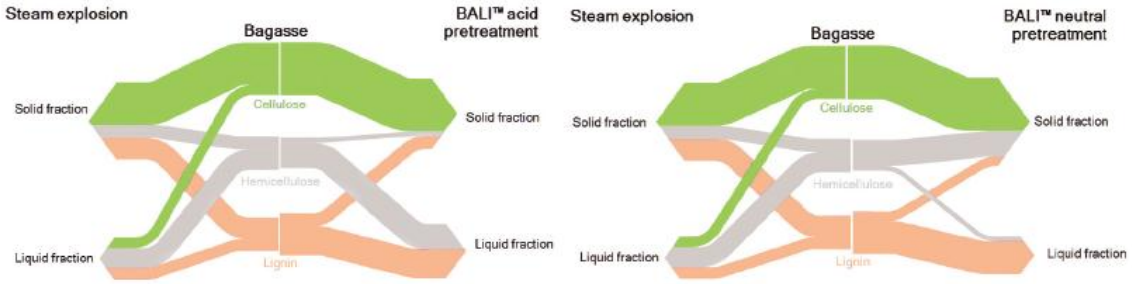
Probability of commercial implementation: In the short-term, the probability of commercial implementation is low due to unfavorable economics under the current state. However, we clearly identified the points that must be studied to bring this Value Chain to reality in the mid-term, which will require a further project.

3- Borregaard BALI technology - BORREGAARD

Very few lignocellulosic biorefinery processes have reached full-scale production scale yet. Most of the intended processes are based on steam explosion pre-treatment and enzymatic saccharification combined with incineration of the lignin and other residues to produce heat and power. The biggest challenge with these types of technologies (steam explosion, weak acid and ammonia pre-treatment etc.) is the relatively low yield of valuable products from all parts of the biomass. In this context, Borregaard has designed, constructed and commissioned an integrated biorefinery pilot that process 1-1,5 metric tons of dry biomass per day. The pilot plant includes all unit operations that would occur in a full-scale commercial plant (feedstock handling, chemical preparation, pretreatment, enzymatic hydrolysis, lignin processing and fermentation).

BALI demo plant.





The BALI-process aims at utilising low value biomass and converting both the carbohydrates and lignin to various competitive products. The entire process consists of four major steps, first a pretreatment or fractionation where the lignin is made water soluble and separated from the cellulose. The hemicellulose is either preserved or hydrolyzed into soluble monosaccharides. Furthermore, the liquid fraction (lignin) is processed to fulfill specifications of a commercial product. The other fraction, solid phase, is transformed to monosaccharides through enzymatic hydrolysis thereafter the sugar solutions are processed (either with fermentation or chemical modification) to the end product. A very unique and important advantage of the BALI technology is the utilisation of lignin as a speciality chemical. The pretreatment also generates a carbohydrate fraction that can be hydrolyzed with enzymes under industrially relevant conditions, due to the low lignin content of the pretreated fibers. The resulting hydrolysates are relatively easily processed (through fermentation or chemical modification) due to the high sugars purity.

Switchgrass. **Giant Reed.** **Miscanthus.** **Sunflower oil cake.** **Willow.** **Bagasse.** **Spruce.**

Five different materials, namely switchgrass, giant reed, miscanthus, sunflower oil cake and willow were received from EuroBioRef partners (UWM, DTI and CRES) and pretreated at the lab scale. In addition to this two more raw materials, bagasse and spruce were pretreated and evaluated in the lab and at the demo/pilot scale.

Pretreatment processes for switchgrass, giant reed, miscanthus, sunflower oil cake, willow, bagasse and spruce have been developed. Pretreated miscanthus, giant reed, switchgrass, willow and bagasse can be hydrolyzed with high glucose yields. On the contrary, sunflower cake showed to be very difficult to hydrolyze. Willow, bagasse and spruce were the three raw materials that gave the best performance of the produced lignin. Optimal pretreatment and hydrolysis conditions for bagasse, willow and spruce were determined in the lab. The results were used as a basis in the scale-up work for bagasse, spruce and willow. For pretreatment, critical scale-up factors included going from batch to continuous process and mechanical issues, and for the hydrolysis, bacterial contamination and process control strategies. These factors have been identified and addressed at the lab scale before implementation in the pilot unit. Overall, the project has been successful and moved Borregaards position to evaluate, scale-up and commercialize the BALI process significantly forward, with a full scale unit envisioned for 2017.

4- Castor Cultivation in Madagascar – SOABE

Biomass type and design volumes / Product type(s) and design volumes

The Ricinus type of castor comprises only the Ricinus *communis* species. It is a laticiferous shrub with large root development and ramified stem, sometimes starting from the base. The plant has green or red alternate petioles and palm like lobed leaves. Monoecious plant, the flowers are in alternate cluster of cymes (or **racemes**) and the inflorescences are either axillary or terminal. The fruits (or **capsules or Hull**) consist of tri-shell spiked capsules. The capsules are dehiscent and release three ovoid seeds.

Castor plant; © Arkema.

Castor oil plant is a tropical plant, which is cold sensitive. It thus grows best in a zone having from 700 to 1000 mm rainfalls that spread out on 5 or 6 months, followed by a fair length of dry season, which brings the fruits to maturation. Castor oil plant is a summer plant requiring plenty of light. It requires fertile soils with a mix of silt and sand or clayey soils (with 1.3 to 1.5 m depth), with a pH comprised between 6 and 7.

Castor hulls, capsules and seeds; © Arkema.

The castor seed's composition is between 40-55% oil. The average oil content of the current varieties is 53%. These hold 80 to 95% of ricinoleic acid.

Castor crop is ideally cultivated on the west part of Madagascar. In fact, because of the significant rainfall over 6 months followed by dry period, this area is suitable for castor as it allows the fruits to wither on the stalk. This facilitates manual harvesting.

Capital required / Expect annual turnover and margin over annual expenditures

In the EuroBioRef project for castor crop farming, we have implemented a crop rotation strategy that aims simultaneously at reducing the impact of diseases on the plants and at decreasing the mineral fertilization rate added to the plant by using leguminous plant. The crop rotation is done for 2-3 years. This crop rotation limits the disease problems and reduces by 30% our mineral fertilization supply to the castor crop. It also allows us to improve the soil quality and provides an additional food crop to the farmers. The castor crop is implemented on a soil that has never been cultivated in Madagascar.

The castor crop cultivation yields, depending on the condition, between 800 kg to 2000 kg with an average of 1300 kg. The world market prices of castor seeds are around 500 euros per ton. With the average yield, the castor crop cultivation can bring a turnover of 650 euros per hectare to the farmer, whereas that of the corn is 450 euros for the same amount of work and fertilizers on the cultivation.

Expected permanent jobs created / Next steps planned

The demand of the Group ARKEMA to limit its risk of supply is important. In Madagascar, our plan is to implement between 5000 and 10000 hectares over 5 years. At a rate of 2.5 hectares per farmer,

this project can bring a new farming of 5000 ha to over 2000 farmers and increase their income by more than 50%. The crop rotation increases the cultivation surface and reduces the rice importation by 10%.

It is clear that on this project we benefit from the collaboration with the Group ARKEMA. But our oil productions interest also the Chinese and German consumers for the making of polymer, lubricants and for the cosmetic market.

Anticipated start-up year / Identified barriers to commercial development

At the end of project, we can say that the production of castor in Madagascar is economically interesting for Malagasy farmers. The principal barriers for these productions are:

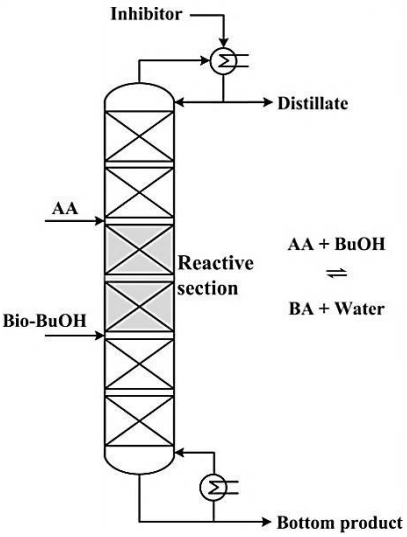
Agronomical aspect. We do not have enough experience of potential disease, we must carry out continuous behavioral test of the varieties to validate the best in long period. We must further train the farmers on the method to conduct the castor cultivation (a good agricultural practices booklet has been produced to this respect);

Economical aspect. We must financially help the farmers to acquire the fertilizers and pesticides to limit the risk of culture.

5. Reactive distillation of butyl acrylate - TUDO

The production of acrylic acid (AA) and its derivates receives an increasing attention, as they are basic building blocks for the chemical industry.[1] The overall world production of AA increased from 3.4 million tons per year in 2003[1] to 4.7 million tons per year in 2006,[2] and an increase in the acrylic acid global demand was predicted by almost 5 percent until 2015.[3]

n-Butyl acrylate (BA) is the most important derivate of AA accounting for almost 30 % of the AA global demand.[4] In the course of the EuroBioRef project, the synthesis of bio-based *n*-butyl acrylate in a reactive distillation column was investigated. *n*-Butyl acrylate is produced in an esterification reaction from acrylic acid and *n*-butanol. A heterogeneously catalysed reaction distillation column for the production of *n*-butyl acrylate was investigated by the TU Dortmund University and Arkema. A production capacity of 20 kta bio-butyl acrylate with a minimum purity of 99.7 % was taken into account. A successful experimental investigation of the reactive distillation process in pilot-scale was performed in Dortmund using biobutanol. The experiments were successfully performed for one reactive and one non-reactive operation, and agreed with the previous results of “chemical” butanol, demonstrating the feasibility of the bio-butyl acrylate production in a reactive distillation column. Based on an economically optimised reactive distillation process using conventional raw materials, the feasibility of using bio-based resources in an industrial scale was investigated using a validated computer model. A methodical approach was developed to identify the most critical impurities for the reactive distillation column. Based on these results, an operating window was found, which enables an in-spec production of 20 kta bio-butyl acrylate in the optimised reactive distillation process without changes on the process set-up. For this process, capital investment of 5.7 MEuro and operating costs (excluding the required raw materials) of 2.6 MEuro per year are required.[5] A further cost reduction is possible by the implementation of a decanter.



Set-up of the pilot-scale reactive distillation column.

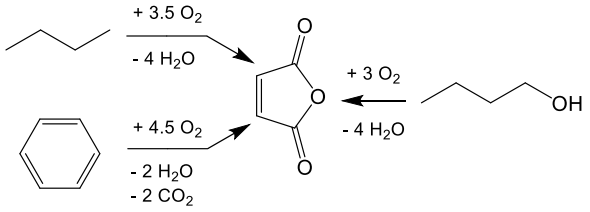
For the industrial implementation of this process, further investigations using bio-based butanol and bio-based acrylic acid are required, and both biochemicals need to be available at the an industrial scale in Europe. The commercial implementation of this process concept is strongly linked with the availability of these reactants. An industrial implementation of this concept will be technically and economically feasible, as soon as both bio-based reactants are available at an industrial scale.

[1] Bell, S.I., 2003. Acrylic Acids and Esters. Report No 6D, California.
[2] Glauser, J., Blagoev, M., Fujita, K., 2007. CEH Marketing Research Report: Acrylic Acid and Esters, California.
[3] I.H.S. Inc., 2011. Acrylic Acid, Acrylate Esters and Superabsorbent Polymers, Colorado.
[4] Nexant In., 2006. PERP Program – Acrylic Acid, New York.
[5] Niesbach et al., 2013. Chemical Engineering Science 100. pp.360-372.

I.3.2.3. Five major scientific results

1- Oxidehydration of *n*-butanol to maleic anhydride - CIRCC, ARKEMA, ORGACHIM now RUSE CHEMICALS, PDC

The research work was aimed at the development of a catalytic process for the transformation of the bio-alcohol ***n*-butanol** into **maleic anhydride (MA)**.



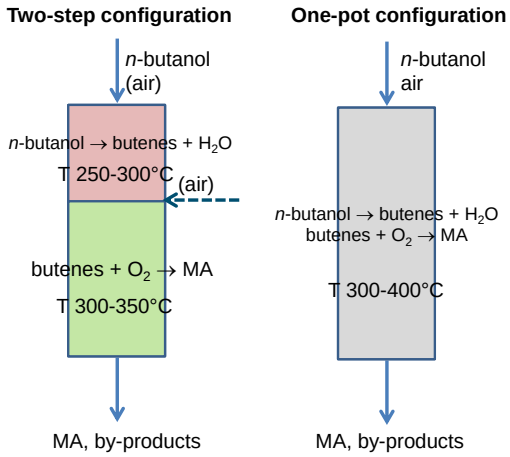
Conventional (from left) and innovative (from right) renewable-based synthesis of MA.

MA is currently produced with a world capacity of 2.7 M ton per year. MA is used in several applications, such as manufacture of unsaturated polyester resins (for the construction, automobile and marine industries), for lubricating oil additives, in food industry, personal care and as an intermediate.

Nowadays, MA is produced from fossil-derived building blocks, *n*-butane and benzene. The research within EuroBioRef was aimed at finding a catalyst, which might allow efficient and selective transformation of *n*-butanol, a bio-alcohol also produced within EuroBioRef, into MA.

Two different process configurations were investigated:

1. A two-step process, involving *(a)* the acid-catalysed dehydration of *n*-butanol to butenes, and *(b)* the subsequent oxidation of butenes to MA. The two different catalytic layers can be combined within a single vessel, with separate zones for the control of temperature;
2. A one-pot process, that is a direct transformation of *n*-butanol to MA, with a catalyst combining both acid features and oxidizing features.



Schematics of the two-step and the one-pot configuration for *n*-butanol oxidehydration to MA.

The two approaches provided comparable results. The optimal catalysts for each step in the two-step process and for the one-pot process were identified. In the case of the direct transformation, the optimal catalyst is based on $(VO)_2P_2O_7$ (vanadyl pyrophosphate).

Based on the achieved results, it was decided to focus on the direct (one-pot) approach, and to upscale the reaction from the laboratory to the pilot unit available at Ruse Chemicals. Industrial batches of catalyst suited for the use in the pilot unit was prepared by Arkema.

Catalytic performances in n-butanol transformation into MA: best results at the lab scale.

Process Configuration	*Catalyst*	*Molar Yield (%)*
Two-step: 1st step	Silica-alumina	Butenes: 98
Two-step: 2nd step	Vanadyl pyrophosphate	MA: 38; PA:
One-pot	Vanadyl pyrophosphate	MA: 39; PA: 12
One-pot	Arkema 1 (vanadyl pyroph)	MA: 43; PA: 6

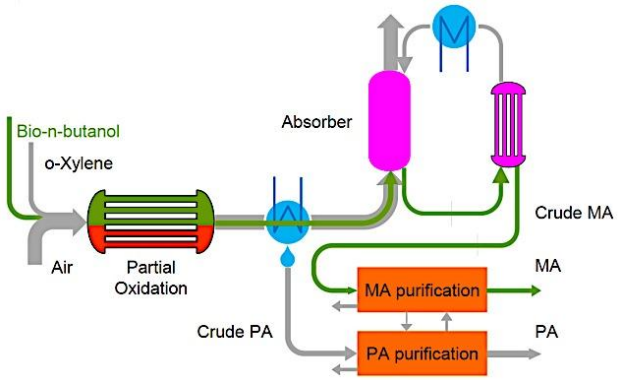
To this aim, the active phase based on vanadyl pyrophosphate was dispersed over an inert support. Pilot tests were carried out using both chemical *n*-butanol and bio-*n*-butanol, the latter either prepared within the EuroBioRef consortium or supplied by external companies. The obtained yields were in line with the results obtained at the lab scale.

The reaction investigated and successfully implemented at the pilot scale level is an example of how it is possible to combine several steps in a single reactor, using properly designed **bifunctional catalysts**, and developing the so-called “cascade” approach. The same type of configuration is exploitable for all those reactions that are based on bio-alcohols taken as building-blocks (bio-based platform molecules), and that are investigated with the aim of replacing conventional technologies starting from fossil-based resources.

Pilot unit - Ruse Chemicals.

Results of pilot plant runs carried out by Orgachim, in direct (one-pot) *n*-butanol oxidehydration.

Reactant	*Catalyst (vanadyl pyro.)*	*Molar Yield (%)*
Chemical *n*-butanol	Arkema 1	MA: 43; PA: 5
Bio *n*-butanol (Cathay)	Arkema 3	MA: 40; PA: 12
Bio *n*-butanol (Cathay)	Arkema 4	MA: 41.5; PA: 1.5



Co-location scenario: integration of PA (and MA) production from *o*-xylene with MA (and PA) production from *n*-butanol.

One unexpected result of the reaction of *n*-butanol oxidehydration is that one "by-product" obtained is phthalic anhydride (PA), which is indeed a valuable compound. Overall, the products are the same as those obtained in the industrial process of *o*-xylene oxidation, which although aims at PA production, but also produces MA as a valuable compound. Therefore, this provides the technological and economical basis for a downstream integration of the two reactions. In other words, the same units currently used in *o*-xylene oxidation plants for products separation and purification can also be used for *n*-butanol oxidehydration. Even more interestingly, the two reactions might be carried out simultaneously in the same reactor, if the catalyst and conditions are the same for both of them. In an alternative configuration, the multitubular reactor used for *o*-xylene oxidation might be divided in two sections, with separate inlet feeds and separate catalysts, each one dedicated to one of the two reactions. Also in this case, the use of an already available reactor would anyway enable a considerable saving of investment costs.

One important argument to take into account is that, nowadays, several chemical companies in Europe cannot withstand big investments for the implementation of new technologies. Even more importantly, there are technologies that are going to be phased out, because of environmental and safety limitations imposed by law. One example is just the production of PA, a product that will be likely banned because of concerns related to phthalates long-term toxicity and potential disruption of endocrine system in human body. Therefore, the integration in the same industrial continuous unit of two different reactions might provide a remarkable operational flexibility, finally allowing tuning the production in function of market requirements.

Within Value Chain 6 ("Integration of EuroBioRef Technology in existing assets"), PDC evaluated investment costs for the revamping of an industrial unit for PA production into a process for the joint production of MA and PA, fed with both *o*-xylene and *n*-butanol. As expected, costs were by far lower than those required for a new plant.

The approach examined within VC6 represents an option of potential enormous impact on the chemical industry, providing a solution for the replacement of concern chemicals with new processes based on renewables.

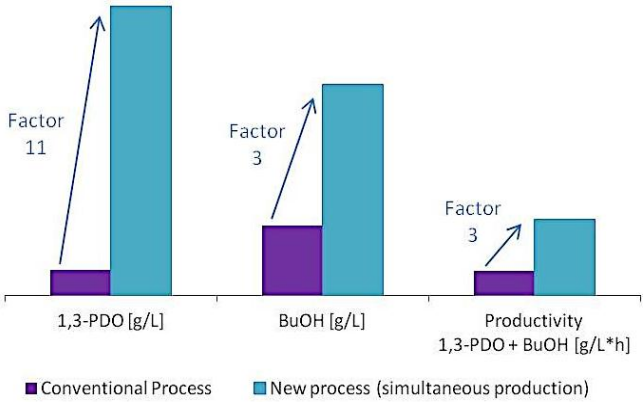
The technologies described here, have been included on Technology Offer from the project (http://eurobioref.org/index.php/28-technology-offers-and-needs).

2- Biotechnological co-production of *1,3*-propanediol and butanol - TUHH, ARKEMA, BKW

Mini plant at TUHH and pilot plant at BKW for the simultaneous production of *n*-butanol and *1,3*-propanediol.

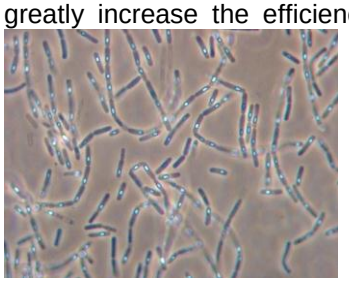
n-butanol and *1,3*-propanediol (1,3-PDO) are two important chemicals of industrial interest. Butanol is an important industrial solvent used for the synthesis of various chemicals and is widely recognized as a better fuel than ethanol. It can also be used alone as a pure fuel in existing cars without modifications. *n*-butanol is also used in the synthesis of butylacrylate, butylacetate and glycol ether formulations. On the other hand, *1,3*-propanediol is a monomer that is useful in the manufacture of polyesters and polyurethanes like poly-trimethylene terephthalate and poly-trimethylene carbonate, which is used in the production of new textile fibers. Worldwide, there are large interests and efforts to produce *n*-butanol and 1,3-PDO from renewable biomass material by using fermentation technologies with microorganisms.

Conventionally, one specific fermentation process is used to produce either 1,3-PDO or *n*-butanol by using one specific microorganism such as species of Clostridia. The most commonly used strategy is fed-batch fermentation, because it combines relatively high product concentrations with a low excess of substrate in the fermentation broth, both of them are critical for the downstream processing. However, the accumulation of butanol as the main product and of some by-products such as acetate and butyrate can cause inhibition of the producing organism. Moreover, the costs for downstream processing of these bioprocesses are quite high and hinder their commercialization.



Production improvement of the new process.

Within the frame of the EuroBioRef project, researchers at the Hamburg University of Technology (TUHH) in Germany has developed, in cooperation with ARKEMA, France, an integrated novel fermentation process for simultaneous production of butanol and 1,3-PDO. The process uses the bacterium *Clostridium pasteurianum* grown on raw glycerol and/or biomass hydrolysate. This can greatly increase the efficiency of substrate utilization and thus reduce the production costs. In a conventional bioprocess, about half of the substrate is converted to the so-called byproducts including CO_2. In the new process, the substrate is mainly converted to 1,3-PDO and butanol. Another innovation of the process is the in situ removal of the toxic product butanol by gas stripping. In such a way, both butanol and 1,3-PDO are simultaneously produced up to concentrations of 45 g/L (cumulative, thus including the stripped fraction) and ~60 g/L, respectively. Moreover, with the *in situ* butanol removal, the overall yield of both products increased to a value of 0.45 g (butanol + 1,3-PDO)/g substrate compared to 0.38 g (butanol + 1,3-PDO)/g substrate in a conventional process. The experiments were performed at lab scale and then refined in semi-pilot scale reactors. In collaboration with the industrial partner BKW in Germany, fermentations were further upscaled in a pilot plant.

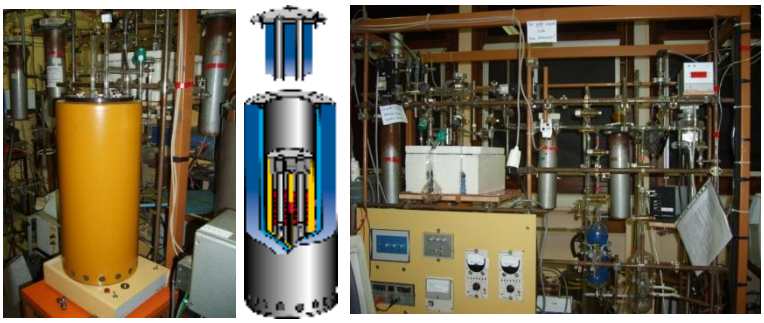


***Clostridium pasteurianum* DSMZ 525.**

3- Gas phase fatty nitrile synthesis - CNRS-IRCELYON and ARKEMA

The dehydration of fatty acids/esters into nitriles has been investigated as a way of valorizing oils derived from biomass, both in gas phase and liquid phase processes.The nitriles having substrates of complex structure (aromatic, hetero-cycle…) are of a great importance as synthetic intermediates for the preparation of pharmaceuticals, agricultural chemicals and dyes, the fatty nitriles (C11-22) have been slightly disregarded by academics, and the industrial processes manage the one-pot ammoniation-double-dehydration at high temperature (usually 300°C). Under such conditions, the catalysts are submitted to harsh conditions and their behavior are rather difficult to observe.

Gas and liquid phase reactions were investigated, where both selectivity and efficiency were related to the acid-base character of the respective catalysts, with the aim to decrease the reaction temperature of about 100 °C and at producing short chain fatty nitriles. In the liquid phase a temperature decrease of only 50 °C was obtained, while the use of the gas phase enabling the temperature reduction goal.



Calorimeter and volumetric line used to characterise the catalysts.

The experiments of gas-phase (catalytic bed processed) ammoniation-dehydration of fatty esters into nitriles were conducted with modified *γ*-alumina, modified hydrotalcites and series of amphoteric mixed oxides, of which the features were assessed using adsorption microcalorimetry of NH_3 and SO_2, and temperature-programmed reduction/oxidation. Under these less corrosive conditions than those occuring in the liquid phase, the catalysts exhibited a heterogeneous character, and the stability of the catalyst's features (acid/base, redox, dispersion of supported material…) was studied. The dehydrogenation/dehydration competition was found to be correlated to the acid features, and the bifunctional (redox and acid/base) catalysis needed an appropriate balance to reach higher efficiency.

It was observed that the rate-determining step of the ester conversion reaction was controlled by the volumic density of medium strength acid sites (with an ammonia adsorption energy between 120 and 140 $kJ.mol^{-1}$), and was most probably assignable to the attack of the nucleophilic carbon by an adsorbed form of ammonia. This would correspond to a turnover frequency of about 3.10^{-2}. No correlation with basicity was observed, and, furthermore, basic catalysts displayed poor efficiency. The dehydration of amide occurs at the surface of the catalysts and is helped by the presence of labile protons in the form of ammonium. At 300°C, the rate-limiting step is the ester conversion to the amide, and ammonia adsorption is not limiting. The advantage of the gas phase process is also the short contact time of the reactants and intermediates with the catalyst, making side reactions less probable. Isomerization is especially a key parameter, and this side-reaction was observed to decrease relatively at lower temperatures. The target of converting saturated and unsaturated methyl esters into nitriles was reached on selected catalysts with higher mean residence time at 200°C, with very reduced isomerization. At 200°C no isomerization was observed and the nitrile yield reached 61mol.% at 11.3 s mean residence time. Concerning methyl laurate conversion at 200°C, it could be increased to 80 mol.% at 20 s mean residence time.

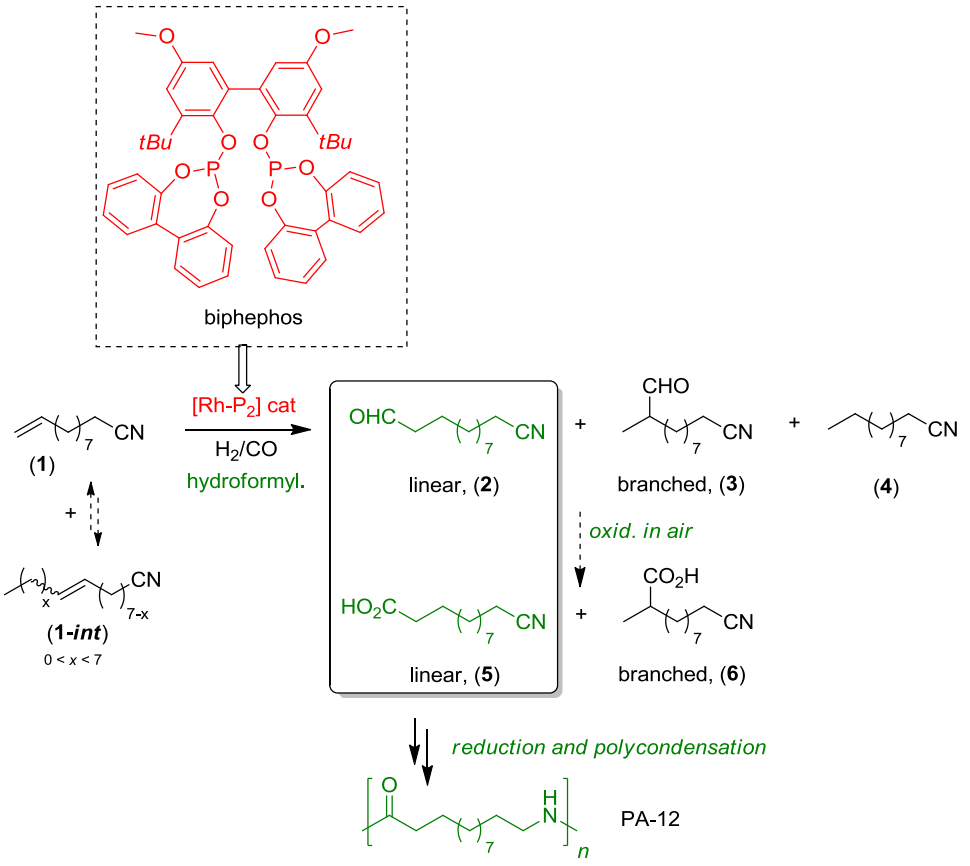
Further work should allow more precise tuning of the acidic character of the catalysts in order to increase the nitrile yield.

The technology developed has been listed in the Technology Offers from the project (http://eurobioref.org/index.php/28-technology-offers-and-needs).

4- Hydroformylation of fatty nitriles - CNRS-RENNES

The use of renewable compounds derived from the biomass has recently focused the interest of researchers in a context of depletion of fossil resources. Among them, fats and oils present a strong potential for a variety of applications. In particular, *10*-undecenoic acid derivatives constitute valuable feedstocks readily available from castor oil. Their transformation by ruthenium-catalyzed cross-metathesis, as developed within the EuroBioRef project, has recently opened up efficient routes towards series of synthetic intermediates which can be used for the production of industrially important technical polyamides ("Nylons" or so-called PAs) like PA-11 (Rislan®) and PA-12. Among these

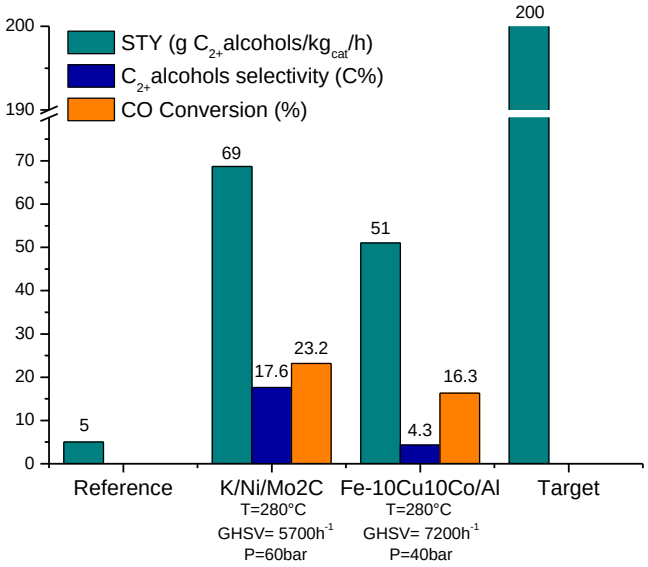
synthetic intermediates, *10*-undecenitrile (**1**; see Scheme below) is a valuable – although yet largely unexplored – compound that can be readily prepared upon ammoniation of *10*-undecenoic acid. Its carbonylation can provide access to C12 *α,ω*-amino carboxylic derivatives, which are direct precursors of PA-12, a technical polymer of major interest to the EuroBioRef partner ARKEMA.



Global reaction principle to P12.

The article by Ternel, Couturier, Dubois and Carpentier in *Adv. Synth. Cat.*, **2013**, reports on the hydroformylation – a fully atom-economic and well-known industrial process that enables the conversion of an olefin by treatment with a CO/H_2 mixture into the corresponding aldehydes – of *10*-undecenitrile (**1**) in the presence of rhodium-phosphane catalyst systems (see Scheme above). Under optimized reaction conditions, the corresponding linear aldehyde (**2**) can be prepared in high yields and regioselectivities with a $Rh(acac)(CO)_2$-biphephos catalyst, two readily available precursors. The hydroformylation process is accompanied by isomerization of **1** into internal isomers of undecenitrile (**1-*int***), which is an undesired side-process limiting the selectivity and final yield. Yet, it is shown that the Rh-*bi*phephos catalyst effectively isomerizes back **1-*int*** into **1**, eventually allowing high conversions of **1**/**1-*int*** into **2**. Moreover, recycling of the catalyst by vacuum distillation under controlled atmosphere was demonstrated over 4-5 runs, leading to high productivities up to 230,000 mol(**2**)·mol(Rh)$^{-1}$ and 5,750 mol(**2**)·mol(*bi*phephos)$^{-1}$. These data demonstrate that the hydroformylation process is industrially viable. Auto-oxidation of the linear aldehyde **2** into the fatty *10*-cyano-2-methyl-decanoic acid (**5**) was also studied and shown to proceed readily upon simple exposure to air at room temperature, which is a green oxidation. Overall, this hydroformylation-oxidation reaction sequence thus opens a new effective entry toward polyamide-12.

5- Higher alcohols (HAs) synthesis from bio-derived syngas over Mo_2C catalysts – CERTH, CNRS-UCCS



Performances in HAs synthesis from syngas.

Pilot for syngas conversion to HAs.

Higher alcohols have been receiving considerable interest recently as suitable green candidates for use in aviation fuel. Gasification of biomass to synthesis gas (H_2/CO), followed by catalytic conversion of syngas, could produce significant amounts of ethanol, plus higher alcohols. These alcohols can be used either as blending components in conventional fuels, or as a feedstock for the production of heavier alcohols *via* the Guerbet chemistry. They can then be directly added to the bio-jetfuel pool. However, the catalytic conversion of syngas to higher alcohols still remains challenging and no commercial process exists today, limited by the low yields and poor catalyst selectivity that has been reported so far. Today's conditions – the high oil prices and the urgent need to unlock energy from biomass for use as fuels employing current infrastructure – have renewed the interest in the synthesis of higher alcohols (HAS) from syngas.

In the frame of the EuroBioRef project, CERTH's task involved the development of improved catalysts for higher alcohols synthesis (HAS), with increased conversion and selectivity under mild operating conditions. Moreover, the work involved the up-scaling of the most promising catalytic materials and the investigation of its long term stability in the pilot scale. CERTH followed an integrated approach of systematic catalyst synthesis, catalytic testing and physicochemical characterization. This allowed developing composition-structure performance relations and obtaining insight on the property requirements for good higher alcohol synthesis catalysts. Catalyst development was based on Cu- and Mo-containing catalysts. Alkali promotion, as well as doping with transition metals, was investigated in order to determine the effect on the catalytic performance and the physicochemical characteristics of the materials. The as-synthesized materials underwent basic characterization (BET, ICP, XRD), but also advanced characterization with SEM and several temperature programmed techniques (TPR, TPD etc) to study the surface and bulk properties of interesting catalysts. In terms of testing, the catalysts were first screened in the reaction of CO hydrogenation to higher alcohols under a fixed set of reaction conditions. For the best performing materials, the catalytic performances were investigated under different reaction conditions (temperature, pressure, H_2/CO ratio etc) in order to optimize the process.

Among the investigated materials, bulk Mo_2C carbides promoted with K and modified by Ni, Mn and Cu exhibited the best catalytic performance. In particular, **K/Ni/Mo_2C** proved to be by far the most active material with a CO conversion of 23% and a satisfactory C_{2+} alcohol selectivity of 17%. The ambitious target initially set in the project was a space-time-yield (STY) of 200 $gC_{2+}OH/kg_{cat}.h$ with a reference yield of 5 $gC_{2+}OH/kg_{cat}.h$. Although the target was not met, the developed catalyst reached **35% of the target** and surpassed by far the reference state-of-the-art yield. The K/Ni/Mo_2C catalyst developed in CERTH exhibited the highest space time yield (70 $gC_{2+}OH/kg_{cat}.h$) at 60 bar with additionally high selectivity to C_{2+} alcohols. The good catalytic performance was attributed to the synergistic effect between Ni and Mo. The effect of sulphur in bio-syngas on the performance of the K/Ni/Mo_2C catalyst was evaluated in a special reaction setup in CNRS-UCCS in the presence of 13

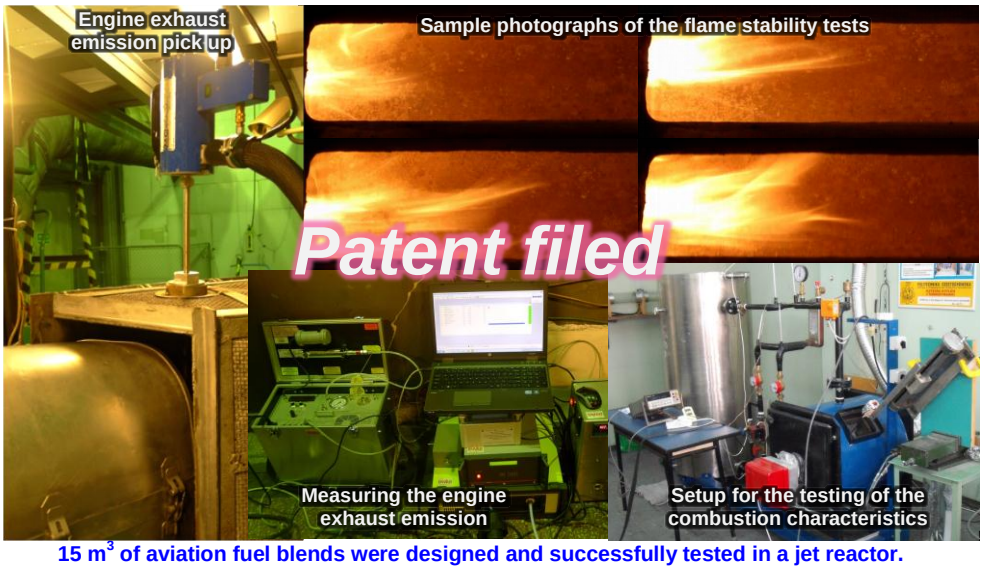
ppm of H_2S. The presence of sulphur in the feed led to some deactivation of the molybdenum carbide based catalyst after 45 h time on stream. This indicates that syngas should be cleaned below these sulfur levels in order to employ the molybdenum carbide catalyst. Alternatively, research could be directed to improving the sulfur resistance of the material. Finally, long-term testing of K/Ni/Mo_2C for the production of higher alcohols from syngas on pilot scale showed that the process can be up-scaled without any significant hurdle. The testing was performed for 17 consecutive days and led to the production of 3.5 kg of product. Concerning the catalytic material, some deactivation problems occurred, leading to a reduction of catalyst activity with time-on-stream. Relatively fast deactivation was observed for the first 6 days, while the deactivation rate was much less in the next days with a stabilizing trend. Characterization of the used sample with BET and XRD showed that deactivation is probably due to sintering, as reduction of the catalyst surface area was recorded. The crystal structure of the catalyst was, however, retained, indicating that the conversion loss is not due to an alteration of the bulk structure of the solid.

To summarize, the K/Ni/Mo_2C catalyst is a promising material for HAS synthesis from bio-syngas under relatively mild operating conditions. The results generated in the EuroBioRef project can serve as a starting point for further research and development of the catalyst and the associated process to TRL levels higher than 4. To this respect, further research axes have been identified:

- Increasing the catalyst activity by supporting the bulk carbide on high specific surface area supports;
- Improving the catalytic stability with time-on-stream by modifying the catalyst structure and providing a stable framework for the active phase;
- Investigating the effect of impurities others than sulfur (such as tars, H_2O, CO_2 etc) to determine the effect on the performance and improve the catalyst composition if deactivation issues are observed;
- Improving the selectivity to higher alcohols and increasing the molecular weight of the products by investigating the recycling of ethanol/propanol in the reactor feed;
- Addressing reaction engineering pertaining to heat abstraction (as the reaction is highly exothermic) in order to be able to operate at a demonstration scale.

I.3.3. AVIATION AND ROAD FUELS

I.3.3.1. Aviation fuel



15 m^3 of aviation fuel blends were designed and successfully tested in a jet reactor.

Outline. In the integrated EuroBioref concept, the molecules being chosen as aviation fuel candidates were derived from non-food sources and processed with methods having potential to lean manufacturing technology. Because aviation biofuels need to have similar properties to crude oil-based fuels, the goal of the EuroBioRef project was to find molecules, processed from raw non-food bio-material, that are compliant with the Jet A-1 fuel standards (most widespread type in Europe), that exhibit combustion characteristics as close as possible to those of the conventional fuel, while being produced *via* short parthways and less energy consuming processes. This task was accomplished by

developing a mixture of Jet A-1 (90%) with *2*-ethylhexan-*1*-ol (2-EH, 10 %) that was identified and demonstrated as a prospective candidate to successfully pass the process required for approval to flight. Regulatory bodies have been contacted to certify this fuel. Further, a second type of aviation fuels, based on heavier hydrogenation products, successfully passed laboratory tests, and further research is needed before envisioning entering in the same certification process.

A) Methodology

Selection procedure. At the lab scale, several potential components provided by EuroBioRef partners were selecting using a simplified but representative list characteristics: density (at 15 °C), freezing point, heating value, electrical conductivity and acid number. The list of these as-selected components included C8 alcohols, C6 alkanes and alkenes, aldehydes, acids, nitriles, acetals and ethers. A measurement campaign allowed us to choose the most promising candidates for further tests, namely material compatibility tests, combustion characteristics tests, as well as compliance checking to particular specifications addressed by ASTM D 1655 and UK Defence Standard 91-91 Specification for Aviation Turbine Fuels:

1- Compatibility tests with engine materials

The goal of these tests was to check if potential detrimental effects can be observed for the chosen candidates during engine operation or fuel storage. Many materials used in the engines, and especially polymers, have a tendency to initially swell by absorbing solvents, when exposed to specific liquids. The degree of swelling depends on the nature of the material and of the solvent. In some cases, a material can swell hundreds of percents of its volume. Swelling is undesirable, as it makes seals and hoses inappropriately sized for their applications and might result in leaks.

2- Combustion characteristics tests

The standard fuel specification provides physical characterization for products that are made from refined hydrocarbons derived from conventional sources like crude oil natural gas liquid condensates, heavy oil, shale oil, and oil sands. There is an assumption that each conventional source fuel batch being compliant to these specifications will have the same combustion characteristics as other conventional fuels batches that meet these standards. However, this assumption may not be true for fuels of different origin. If combustion dynamics of the new type of fuel differ from conventional fuel, the engine combustion chamber performance will suffer or will be unsafe. These features are tested during engine test runs. Nevertheless, because various engines have different combustion chamber designs and temperature/pressure characteristics of gas path than other engines, the results from one engine test may not be valid for other designs. Thus, the goal of lab combustion tests was to check to what extent the characteristics of flame during burning of new fuel in laboratory furnace are similar to Jet A-1 flame, including the flame temperature profile and the flame velocity (turbulence) components in all directions.

The above-described tests allowed choosing such candidates that burn most similarity to the standard fuel. Thus, such candidate makes promise that their combustion dynamics will be similar to Jet A-1 for all applications. These candidates were then used for further evaluation and for running the engine tests.

Human health, safety and environmental evaluation. Human health, safety and environmental evaluation included comparison of new candidate with conventional fuel the safety and environmental data to convince its compliance with applicable rules.

Engine ground tests. The engine ground tests campaign included the simulation of all the operations being used during aircraft flight conditions, namely, engine start, accelerations and decelerations, flight ranges and stops. The measurements of the engine power or thrust, fuel consumption and gas path temperature allowed for determining to what degree the power characteristic with the new fuel meets the aircraft requirements and check if thisnnew fuel is economically attractive. The durability of these tests was such that it allowed for preliminary evaluation of the engine parts conditions after certain hours of operation with the new fuel. A total of more than 50 hours of operation was applied. For the tests, two engines were run, having different temperature of gas path. Also, some runs were made with a percentage of new molecules higher than that specified for future use to test possible excess events during operation. The endurance tests allowed also for measurement of exhaust emission for comparison with standard fuel emission.

B) Results

Laboratory tests. These tests were carried out at OBR PR (Plock, Poland). The results of selected molecule tests against particular specifications addressed by ASTM D 1655 and UK Defence Standard 91-91 Specification for Aviation Turbine Fuels are given in the respective tables hereafter.

Composition of the EuroBioRef JET A-1 / 2-EH (*2*-ethylhexanol) blends used for lab tests.

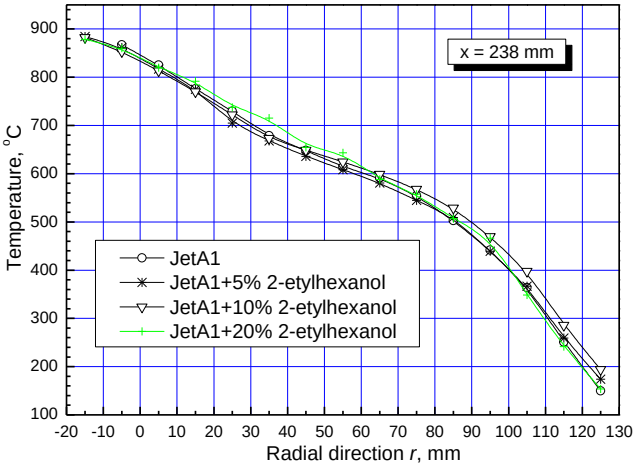
Composition	#	J/130	J/131	J/132	J/133	J/134
JET A-1	% Vol.	100.0	98.0	95.0	90.0	85.0
2-EH		0	2.0	5.0	10.0	15.0

Results of the lab tests on the EuroBioRef JET A-1 / 2-EH blends.

No.	Parameter	Test	Unit	ASTM 1655 limit / Results	J/130	J/131	J/132	J/133	J/134
1.	Density 15 °C	PN EN ISO 12185:2002	kg/m^3	775-840	792.3	792.9	794.0	796.0	798.2
2.	Freezing point	ASTM D 7153-10	°C	< -47	< -60	< -60	< -60	< -60	< -60
3.	Net Heating Value	ASTM D4529-01:2006	MJ/kg	Min. 42.8	43.319	43.281	43.174	43.010	42.812
4.	Electrical conductivity	ASTM D 2624-09	pS/m	M	94	116	126	193	184
5.	Distilation - Start point	ASTM D 86-11a	°C	-	145.9	146.9	144.9	138.5	132.7
	- 10 % Vol.			Max. 205	165.6	165.3	165.0	165.0	165.1
	- 50 % Vol.			Report	181.6	180.8	179.5	178.1	177.3
	- 90 % Vol.			Report	217.8	215.9	214.5	213.3	212.2
	- End point			Max. 300	259.9	259.5	258.8	257.3	256.1
	- Residue		V/V	1.5	1.2	1.2	1.1	1.1	1.1
	- Loss			1.5	0.9	1.0	0.6	1.0	0.9
6.	Corrosion on cupper plate; 2 h; temp. 100°C	ASTM D 130-10	class	1	1	1	1	1	1
7.	Kinematic viscosity at -20 °C	ASTM D 445-12	mm^2/s	Max. 8	3.202	3.300	3.429	3.773	4.138
8.	Exsitent gum	ASTM D 381:2009	mg/100 mL	Max. 7	10	10	10	10	10
9.	Acidity	PN-85/C-04066	mg KOH/g	Max. 0.1	< 0.01	< 0.01	< 0.01	0.01	0.01
10.	Sulfur content	ASTM D 2622-2010	mg/kg	Max.300	891	869	834	785	731
11.	MESP (Water Separation Characteristics)	ASTM D 3948:11	-	Above 70 (with Static Dissipator Additive)	54	80	81	86	99
12.	Thermal stability JFTOT - Temp.	ASTM D 3241:13	°C	260	260	260	260	260	260
	- Pressure drop		mmHg	25	1.3	< 1	< 1	< 1	< 1
	- Tube deposits		grade	< 3	< 1	1	1	1	< 4

Compatibility tests with engine materials. These tests were carried out at DTI using high density polyethylene (HDPE), fluorocarbon, fluorosilicone, NBR-high acrylonitrile, NBR-low acrylonitrile, HNBR, and IRP 1078 rubber as materials. The weight change was selected as the parameter that characterizes the material compatibility with the selected candidate. A sample of the material under test was weighed, immersed in a conventional fuel for ten days, retrieved, wiped with a paper towel, weighed and immersed in a biofuel for ten days. This operation was further repeated twice before final recovery retrieved, wipping and weighting of the sample. Seven materials were chosen for test with various potential fuel components including the finally selected. The tests with 2-EH especially showed that *(i)* HDPE exhibited moderate weight changes; *(ii)* The high-performance fluoroelastomers, FKM (except with MeOH) and fluorosilicone exhibited only very limited weight changes over the course of the incubations. This is consistent with these being installed in many applications handling aggressive liquids at elevated temperatures; *(iii)* The NBRs went from moderate (low acrylonitrile) to large (hydrogenated NBR and HNBR) weight changes, thus showing incompatibility of this material with Jet A-1; and *(iv)* with IRP 1078 rubber, the weight changes were moderate.

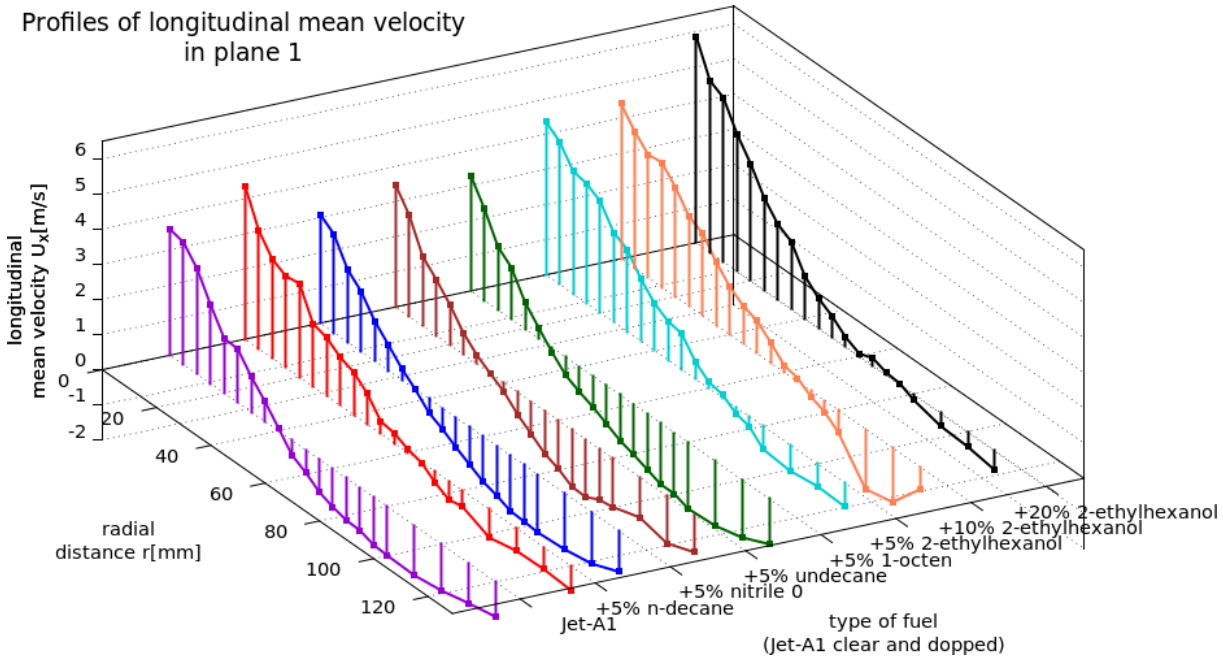
Combustion characteristics tests. The tests were made at Czestochowa University of Technology, Institute of Thermal Machinery (Poland), mandated by WSKRZ. For example, the radial temperature distribution for pure Jet A-1 and for various admixtures of Jet A-1 and 2-EH (5 %, 10 % and 20 % of 2-EH) is shown below.



Radial temperature distribution for Jet A-1 and 2-EH blends.

Temperature measurement setup.

In a second example below, we show the results concerning flow velocity distributions for pure Jet A-1 and for various molecules mixtures with Jet A-1 (including blends with 2-EH).



Flow velocity distributions for pure Jet A-1 and for various molecules mixtures with Jet A-1 (including blends with 2-EH).

These tests showed that *(i)* the radial temperature profiles are similar for all the investigatedfuels investigated, *(ii)* the maximum scatter of the measured temperatures for different fuels is within the range from -30 to +43 °C, *(iii)* the mean velocity profiles for Jet A-1 with 5% and 10 % of 2EH are similar to that of the pure Jet A-1 profile, and *(iv)* the maximum scatter of the mean velocity measured for Jet A-1 bended with 5 % and 10 % of 2-EH is within range from -1 to +1 m/s.

Human health, safety and environmental evaluation. For estimating of the impact that Jet A-1 fuel and *2*-ethylhexanol can have on human health, safety and environment, the respective Material Safety Data Sheet (MSDS) were used. Such MSDS's are issued by various institutions and

organizations and are available in the public domain. The inputs in each section were compared (see the table below).

Comparative examples between Jet A-1 and 2-EH.

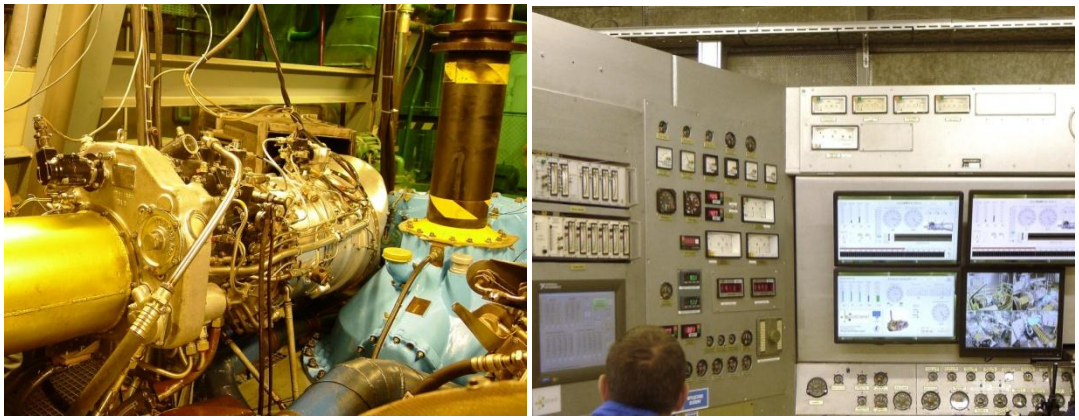
Jet A-1	*2*-ethylhexanol
Hazards identification	
Flammable liquid and vapour. May be fatal if swallowed and enters airways. Causes skin irritation. May cause headache, dizziness, nausea, irritation of the eyes, upper respiratory tract, asphyxiation, unconsciousness and even death.	Combustible liquid and vapour. Harmful if inhaled. Causes eye, skin and respiratory tract irritation. May cause headache, nausea, dizziness, drowsiness, loss of consciousness.
Safety Hazards	
Extinguishing media: Foam, fine water spray and dry chemical powder. Carbon dioxide, Clean agents (*e.g.*, Inergen, Argonite etc.), sand or earth may be used for small fires only.	Suitable extinguishing media: Water spray. Dry chemical. Carbon dioxide. Foam.

The wording of these MSDSs vary, but their comparative analysis can be summarized under the form of this conclusion that there are no substantial differences in human health, safety and environmental features between pure Jet A-1 and pure *2*-ethylhexanol.

Engine ground tests. For the preparation of the engine tests, WSK Rzeszow has verified the parts and assemblies that are exposed to the fuel or exhaust gases. These parts were checked and photographed. The fuel delivery unit have been sent to the manufacturer (subcontractor: HS Wroclaw, Poland) for examination and performance checking after the tests.

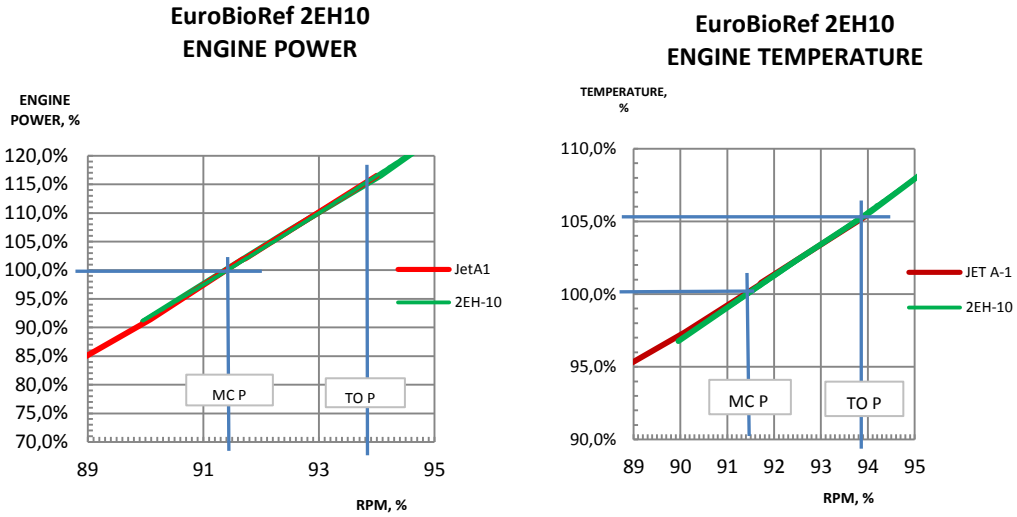
WSKRZ has performed a series of the engine tests in their specific test cell. The engine was tested in the following sequence: standard JET A-1, and then JET A-1 with 10 %, 20 %, 14 % and 10% addition of *2*-ethylhexanol. For each fuel, the runs included the following ratings of the engine power: Flight Idle, 0.9 Max., Continuous, Max., Continuous and Take-Off, and also starts, stops, accelerations and decelerations. During each portion of the tests, the engine performances including fuel consumption (Ce) and exhaust emission characteristics were measured and recorded. Further, each fuel batch was tested for heat value.

The tests were carried using two engines having gas path adjusted to develop normal and excessive temperatures. The total test time for those engines was over 50 h of operation.

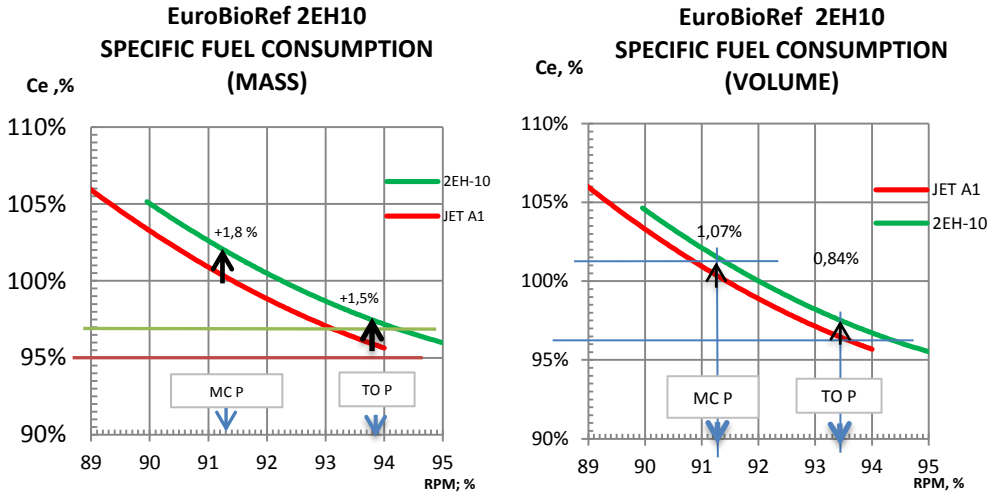


Engine test cell and its control unit.

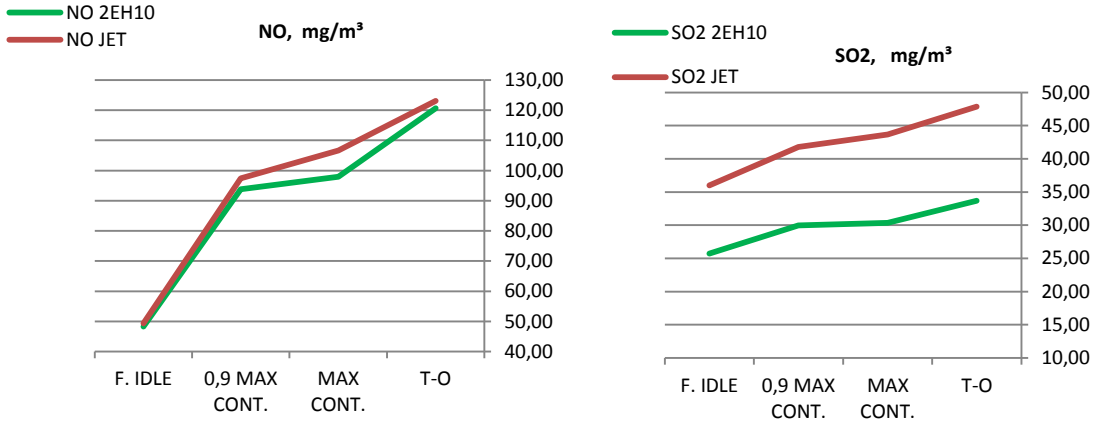
For all the tested blends, the engine operation complied with the requirements. Examples of engine power, temperature and specifics fuel consumption characteristics are given in the figures hereafter.



Engine power and engine temperature for pure Jet-A1 and 2EH-10 (Jet A-1 blended with 10% of *2*-ethylhexanol). MC P = Max Continuous Power; TO P = Take Off Power.



Massic and volumic specific fuel consumption for pure Jet-A1 and 2EH-10 (Jet A-1 blended with 10% of *2*-ethylhexanol). MC P = Max Continuous Power; TO P = Take Off Power.



NO and SO_2 emissions for pure Jet-A1 and 2EH-10 (Jet A-1 blended with 10% of *2*-ethylhexanol).

During all the runs the engine operations were smooth. No visible (*e.g.*, smoke) or audible (*e.g.*, abnormal noise) observations were noticed. No leaks of fuel were observed. The observation of fuel with component after 3 weeks of storage has shown no visible sign of segregation. The observation of

the engine inner parts after test has shown no visible signs of deposits, with the conditions of the parts being the same as those after a standard fuel run.

Some changes in specific fuel consumption (SFC) that were observed between Jet A-1 and Jet A-1 belnded with 2EH can be explained by different Specifics Energy (Net Heat of Combustion) values for each batch. It should be noted that the Specifics Energy for the new fuel candidate (Jet A-1 with 10% of 2-EH) was however within the Jet A-1 specification limits. Thus, it can be assumed that, for other runs with other deliveries of fuel having other Specifics Energy values, the SFC for fuel with 2-EH may not disadvantage operation as that can be implied from this particular test result as shown in the example above. The SFC shown in the above figures is calculated both in "mass" and "volume" units. **"Mass" SFC may be more important for operators who operate short/medium connections and require minimum weight for Take Off to improve the economy. The "volume" SFC may be important for operators who operate long distances and fully fill the tanks to maximise the operation range.**

The emission data shown above are the readings from the measurement system and not the emission indexes according to the ICAO standard.

The contents of sulphur dioxide (SO_2) in the exhaust gases during operation on 2EH-10 are significantly lower than for the same operation done on pure Jet A-1. This can be explained by two factors, namely *(i)* a lower content of sulphur in the base Jet A-1 (shown by analysis of sample for the given batch), and *(ii)* the addition of 10% of 2-EH, which contains no sulphur. Thus, for the whole flight operation, the SO_2 emissions for Jet A-1 + 2-EH fuel can potentially be 10% lower than those for pure Jet A-1, because the additive (10% of 2-EH) contain no sulphur (dilution effect).

The contents of aggregated nitrogen oxides (NO_x), CO and CH_4 in the exhaust gases during engine test on Jet A1 + 2-EH are similar to those observed for pure Jet A-1. The content of HCl is not stable for each mixture, but remains within the 1.5 ± 0.25 mg/m3 boundary for both fuels. The exact effects of new candidate for aviation turbine fuel on HCl emission cannot be identified with required precision because the accuracy of existing measurement systems is inadequate for such short duration of tests.

Further, the 2-EH component provides a static electric discharge protection due to a high electrical conductivity, which would decrease the need for costly special additives for certain applications.

At last, there were observations that the CO_2 emissions of Jet A-1 + 2-EH fuel was 0 % to 2 % lower than for pure Jet A-1 at the same engine ratings. However, because of the relatively short times of the tests, these observations are not statistically quantified with the needed accuracy, and thus requires further research efforts.

C) Summary and future

Summary. During the EuroBioRef project, a new candidate for aviation turbine fuel was developed and characterised. The new candidate is a mixture of a standard Jet A-1 fuel with 10 % of *2*-ethylhexanol additive. This candidate for admixture (2EH) has also desirable environmental properties: it provides electrical conductivity to the fuel which eliminates need for other additives being environmentally uncertain, it is readily biodegradable if spilled to the soil, and it is not bioaccumulative (from SAFETY DATA SHEET). This new candidate for aviation turbine fuel has been preliminary tested to determine with a certain probability if any negative impact on safety, durability, or performance of the engines and aircraft can be observed. These tests included measurements of *2*-ethylhexanol mixtures with Jet A-1 fuel for standard specification properties, flame properties in a test combustion chamber, engine materials compatibility assessment, and engine trial operation runs.

The tests have shown that the bio-originated new candidate for aviation turbine fuel meets certain specifications addressed by the ASTM D1655 Standard Specification for Aviation Turbine Fuels. Also, this new candidate meets most of the specifications addressed by the UK Ministry of Defence Standard 91-91 except one: total acidity. During all the trial operations, the engines have worked smoothly. No visible (*e.g.*, smoke) or audible (*e.g.*, abnormal noise) observations were noticed. No leaks of fuel were observed. The observation of the fuel containing the 2-EH component after 3 weeks of storage has shown no visible sign of segregation. The observation of the engine inner parts after test has shown no visible signs of deposits, the condition of the parts being he same as those observed after standard fuel run.

The information and data shown above indicate that there is certain probability that the candidate fuel may pass the tests for remaining specifications as provided in ASTM D1655 and UK Ministry of Defence Standard 91-91 and also the procedures provided by ASTM D4054 – 09 Standard Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives.

Further, there were two evident environmental gains being observed for the candidate fuel (Jet A-1 with 10 % of 2-EH): First, a reduction of the carbon footprint emissions because of the 10 % addition

of a component of bio-origin; Second, 10 % reduction of sulphur dioxide emission resulting from the addition of 10% of 2-EH that is sulphur-free (dilution effect). Also, there are indications that some reduction of CO_2 emission from the engine during operation on the candidate fuel may be observed. For the other components of the exhaust gas emissions, no evident change in the emission levels was observed. Further, 2-EH addition enables direct optimisation of the static electric discharge protection, which would avoid the use of costly specific additives usually needed to adjust this property.

The work made under Eurobioref program allowed to develop the candidate fuel to the certain levels of readiness for industrial use. Considering the CAAFI (Commercial Aviation Alternative Fuels Initiative) **Fuel Readiness scale, the obtained results shown above allow for classification of the new candidate fuel (10% mixture of *2*-ethylhexanol in Jet A-1) in a rank between Level 5 to Level 6.**

Future R&D tasks. After the EuroBioRef project, the next steps for maturing the new aviation fuel candidate (*2*-ethylhexanol 10% mixture with Jet A-1) shall include:

- Further development of the production technology to optimise the energy consumption and bring down the production cost and also to improve the process to get full compliance with UK Def. Stand. 91-91;
- Initiating the standardization process test program. For this activity, an Action Team is necessary, which will manage the whole process and will include interested parties, *i.e.*, fuel manufacturers, operators, engine and aircrafts OEMs, etc. The general policy on qualification and approval of new aviation turbine fuels and fuel additives is outlined in ASTM guide D4054. But, because there is close international standardization cooperation (mainly between Europe and USA) and tests methods are developing constantly, to specify the details of this process, the UK Aviation Fuels Committee (AFC) or the USA ASTM Committee D02.J0 should be consulted for scope of tests, procedures, costs and accredited laboratories. After that consultation, the tests campaign may be initiated, and, then, other steps (OEM Internal Review, and Specification Change Determination) resumed. Note that all the major European airlines ar part of the ASTM committee. CEN was contacted by the EuroBioRef partners, and it appears that, since Europe is already well represented in the ASTM committees for aviation fuel, it is not necessary to duplicate the work in Europe while the industry is willing to follow the ASTM recommendations/certifications.

Certification process. Further, before completion of the endurance tests, some individuals were already contacted for initiating the certification process for the new blend, namely:

- European Aviation Safety Agency – for certification procedure;
- Polish Normalizing Organization consultants for standardization procedures and review of our up-to-now tests results;
- Cen Cenelc – European Committee for Standardization for the same as above;
- Polish Defence Aviation Institute for technical assessment of the fuel;

Having the test completed, an Information Letter with description of the new fuel was prepared and delivered to a/m and other organizations like CAAFI, Aeroports, IATA.

The key national and international players dealing with aviation fuels, and to be contacted concerning our discoveries are, to summarize: Air Transport Action Group (ATAG), Sustainable Aviation Fuel Users Group – SAFUG, Roundtable On Sustainable Biomaterials (RSB), Commercial Aviation Alternative Fuels Initiative (CAAFI), International Air Transport Association (IATA), Sustainable Aviation Fuels Northwest (SAFN), Airports Council International (ACI), International Civil Aviation Organization (ICAO), European Aviation Safety Agency (EASA), European Committee for Standardization (CEN).

This process is ongoing after the official end date of EuroBioRef.

I.3.3.2. Road fuels

Nowadays biodiesels such as FAME (Fatty Acid Methyl Ethers) and HVO (Hydrogenated Vegetable Oil) are already used commercially in diesel blends, while BTL (Biomass To Liquid) are used on a demo level. This is good progression, but still more biodiesels are needed to fulfill the rising demand for low sulphur middle distillates for both road traffic and shipping industry. Current feed stock is scarce and not always sustainable. While jet fuel was the fuel target set up at the beginning of the project, among the synthesized molecules, we also identified candidates for road fuels during the life of the project. Accordingly, **five**

Road fuels test engine.

different diesel fuel blending candidates were also tested in a light duty road engine. The objective was to determine which candidates are more suitable for blending with diesel fuel for road going vehicles.

Since no detailed fuel analyses were available at this point, the ideal blending percentage was unknown (new objective of the project that was not initially planned). Therefore, all the fuels were tested as 30%Vol. blends. This is indeed a proportion, which should rarely cause trouble in a regular diesel engine. However, this is sufficient to typically enable a measureable impact on emissions and consumption. Other issues such as sedimentation or phase separation could also occur with this percentage, and, thus 30%Vol. were definitely considered as a suitable blend for initial tests.

The main objective of the tests was, as aforementioned, to determine if the blends have any negative effect on the emissions and performance of a standard road going diesel engine. Therefore, the test engine was configured with standard injectors and standard ECU settings. A pressure indicator was mounted in one of the combustion chambers to monitor ignition delay, heat release curve and peak pressure. This enables revealing any issues that might affect the performance of the engine. Especially at cold start, the ignition delay can be a problem, leading to knocking noises and poor combustion. Therefore, the test engine was “cold” started at room temperature. In addition to a steady running at a moderate load, the engine was also operated at its peak nominal power and torque. This was done to demonstrate engine operation at both the highest combustion pressure and highest fuel flow.

Test matrix for road engine tests.

Test n°	Load %	Type	[rpm]	[Nm]	[kW]	Main parameters to be checked
1	0	Cold start and warm up phase	800	0	0	Fuel ignition, steady rpm, abnormal noise
2	30	Steady running	2000	75	-	Fuel consumption, NOx
3	100%	Maximum effective mean pressure	2000	260	-	Fuel consumption, heat release curve, CO, NOx
4	100%	Maximum power	4000	-	80	Fuel consumption, power, ignition delay, CO, NOx

During all the tests, CO_2, CO, HC and NOx emissions were measured. We focused on engine-out emissions because the catalyst- and filter functions were not in the scope right now, for this preliminary assessment. The engine was operated in these load points until all the parameters became constant. Fuel consumptions were determined from intake air mass flow and raw gas CO_2 by the carbon balance method. For cross-checking, the fuel tank was also weighed on a digital scale.

As a conclusion, we found that **four out of the five tested alternative fuels are excellent suggestions for blends with diesel** for light duty high speed road engines, and might be able to be certified after further analysis.

I.3.4. INTELLECTUAL PROPERTY

I.3.4.1. Patents

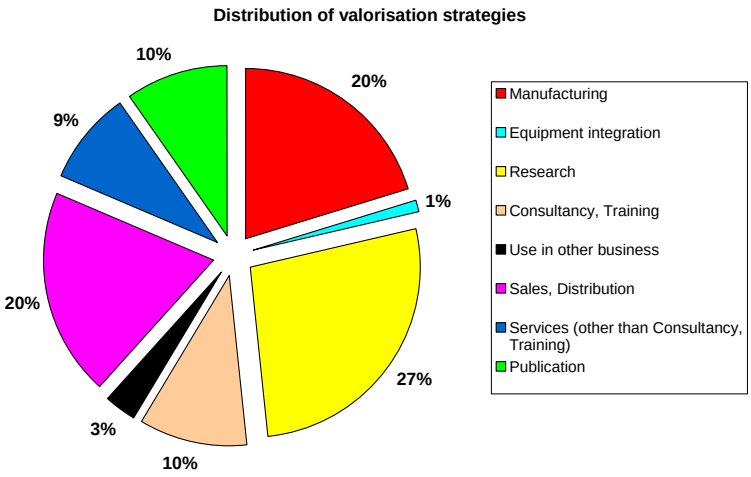
In order to track patent application, a template for exploitation register has been created and was refined. According to the IPR Guidelines, this table was filled in by each partner foreseeing exploitation actions (*e.g.*, patent application, registered design...) and sent to the Exploitation Manager JL. Dubois/ARKEMA. The total number of filed **patent applications filed is 24, leading to a ratio of 1.04 Patent application filed per million euro of public money spent. To date, 10 patent applications have already been published.**

I.3.4.2. Foreground and accessible background

A list **of 97 Foregrounds and Accessible Background** have been prepared. Contributing partners are (partner Number – short name): 1-CNRS, 2-ARKEMA, 6-CRES, 8-CERTH, 9-PDC, 10-Quantis, 12-DTI, 13-TUDo, 14-MERCK, 15-FEUP, 17-CIRCC, 18-WSKRZ, 19-OBRPR, 21-SOABE, 23-NYKOMB, 25-ORGACHIM, 26-IMPERIAL, 28-UWM, 29-TUHH – meaning 19 respondents out of 28 still active at the end of the project. The foregrounds have been gathered in 71 exploitable results.

In all cases, the partners were requested to identify by which means they intend to valorise their Foreground or Accessible Backgrounds.

The figure on the right illustrates the distribution of valorisation actions. Note that the same foreground/background might have several ways of being valorised. In this case it was counted in each category. Not surprisingly for a research project, the highest level of answers (27%) is for **Research** purposes, but the next levels at **20 % are for Manufacturing and Sales/Distribution**. Because of the presence of service companies in the project, we find a reasonable level of answers for use in consultancy, training and services (including licensing).



Distribution of valorisation strategies.

The Second major innovation is the template concerning identification of Foreground and Accessible Background. 97 sheets have been accordingly completed by the partners who generated the Foregrounds. Out of these 97 sheets, **11 concern Accessible Background and 86 Foreground** from the project. The Collection of sheets was handled by the IP Committee, and all of them have been numbered as follows:

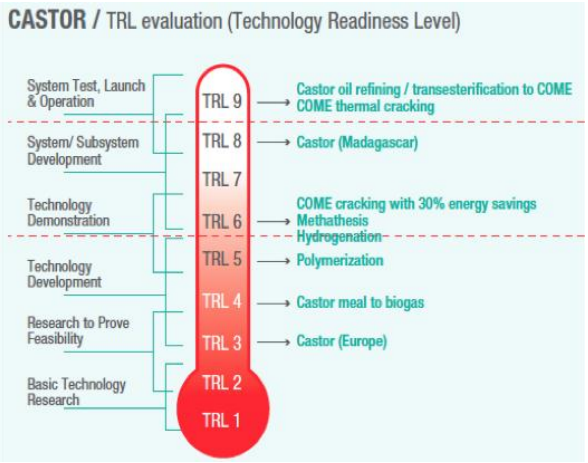
The table below illustrates the cases where **joint Foregrounds** have been generated between partners. It is a kind of representation of where the collaborative work has been the most active.

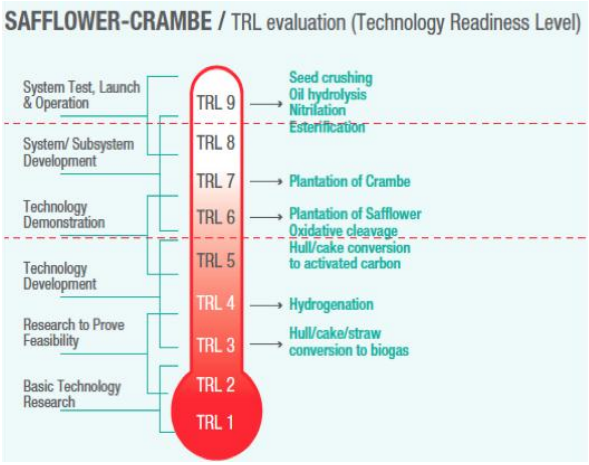
Schematic table showing the joint foreground.

	CNRS	ARKEMA	BORREGAARD	NOVOZYMES	METEX	CRES	HTAS	CERTH	PDC	QUANTIS	EUBIA	DTI	TUDO	MERCK	FEUP	RWTH	CIRCC	WSKRZ	OBRPR	SINTEF	SOABE	UMICORE	NYKOMB	ALMA	ORGACHIM	IMPERIAL	NOVANCE	UWM	TUHH	BKW
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	8	8																												
2		12															12								12					
6		1				1						1									1							1		
9		1							1									1	1											
17		2															2													
9		1							1																					
23		1																					1							
9		1							1								1								1					

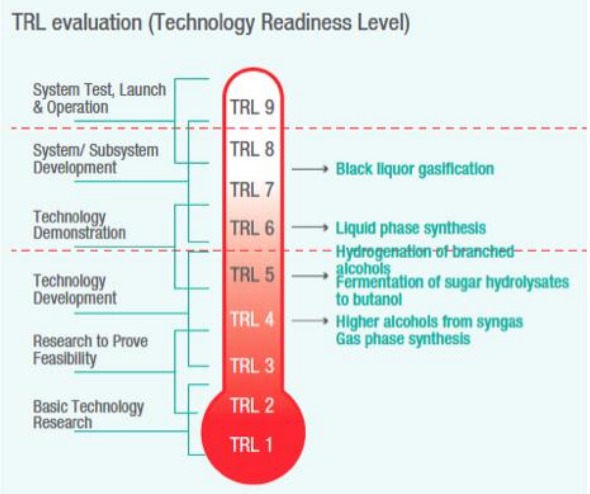
I.3.5. **PATHWAYS AND TRL**

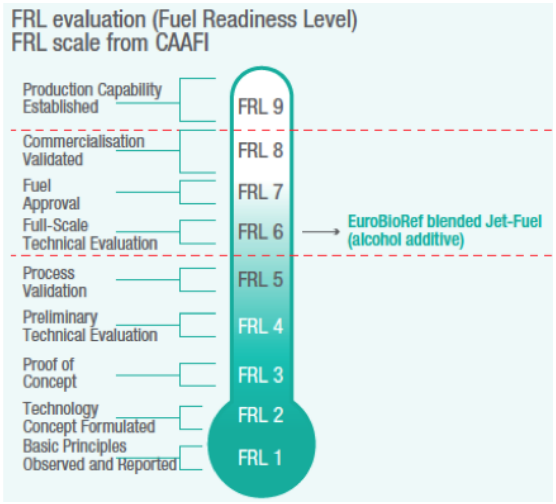
VCs 1&2: Vegetable oils to high value monomers



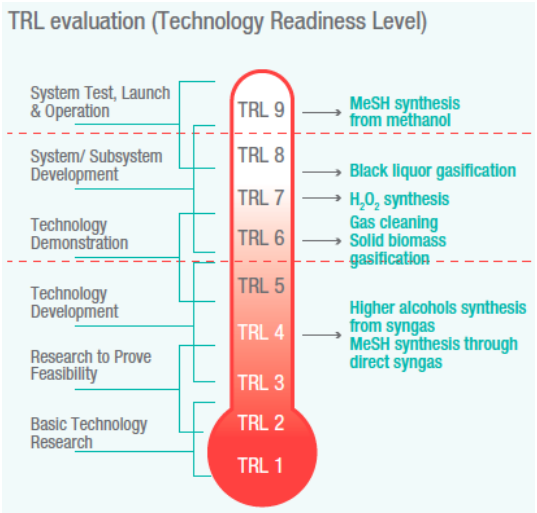


VC3: Lignocellulosics (aviation fuels) biorefinery

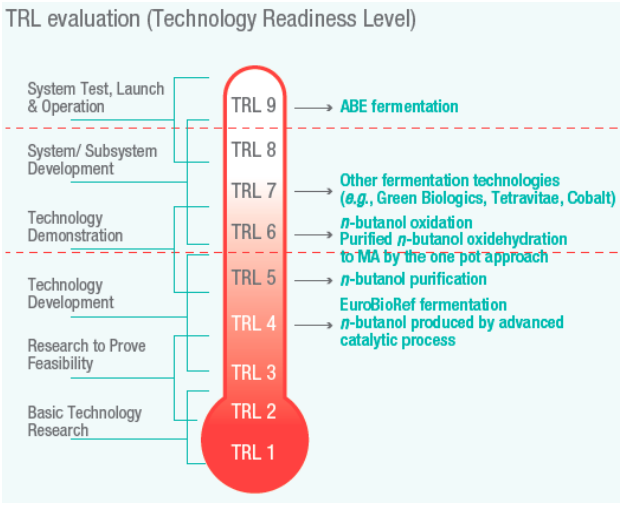




VC5: Syngas-based biorefinery towards higher alcohols, H_2O_2 and MeSH

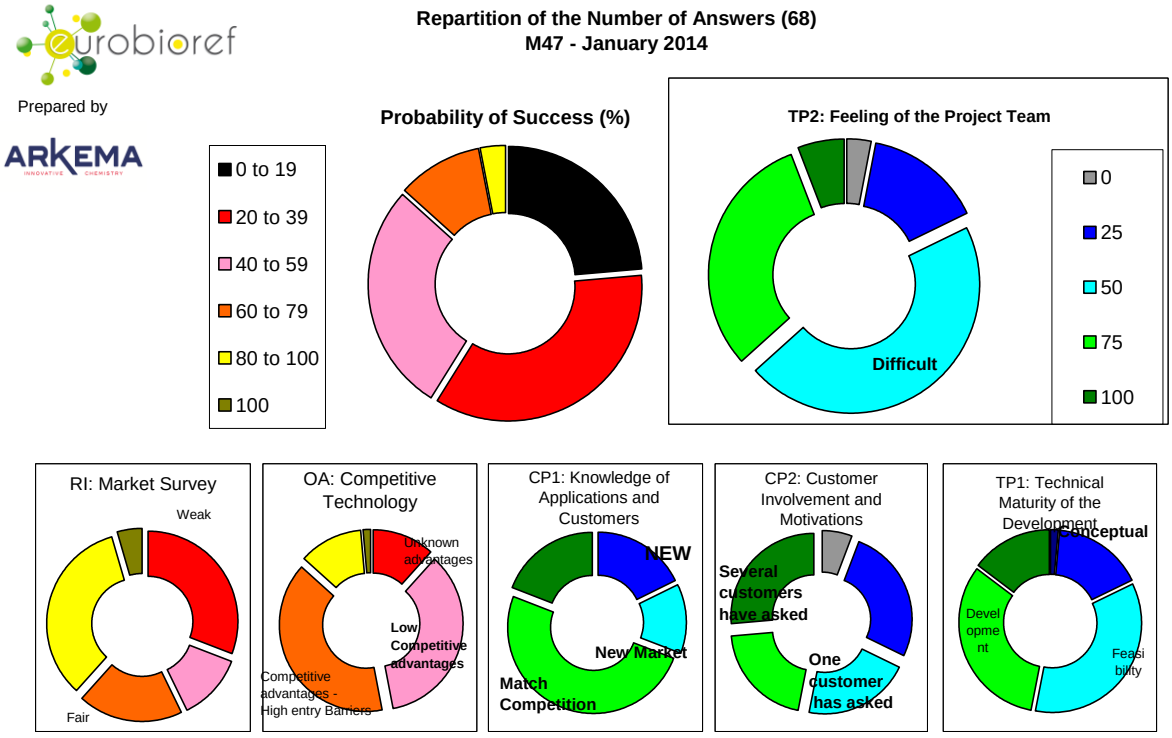


VC6: Integration in existing units



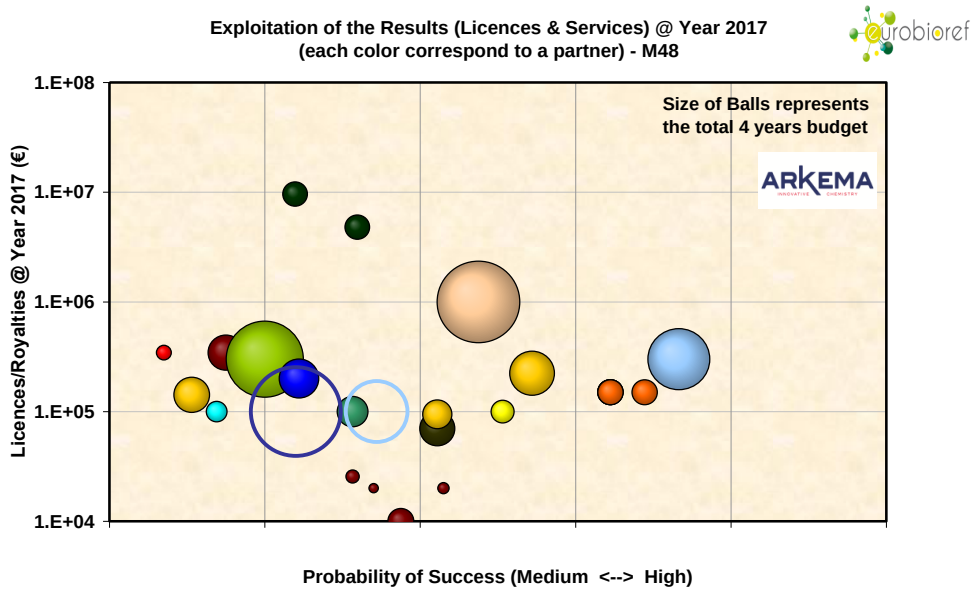
I.4. Potential impact and dissemination and exploitation of results

I.4.1. POTENTIAL IMPACT



Distribution of valorisation strategies.

The above figure is the representation of the analysis of the Probability of Success questionnaire at M48. One third of the answers indicate a probability of success above 40 %. The market knowledge of the partners is good, because 2/3rd of the answers correspond to a better than fair knowledge. The knowledge of market application and customers also changed during the project to reduce the risk with new markets and new customers. There is more commitment from customers, which means that the partners have recognized that their potential customers were the other partners. Finally the about half of the answers suggest a TRL level above 4, and a bit more than 1/8th reached a level above 6.



Impact of the project for year 2017 on Sales or products and on Licenses/revenues from services.

The analysis of the overall project shows a project portfolio with a distribution of projects (figures above), which is well balanced with some more risky tasks, but which, so far, involves a small budget of the project – these are tasks which are still in the feasibility range – and tasks with a high probability of success, which, in general, also correspond to tasks with higher budget, and those that reached the demonstration stage.

The realization of the commercial plan was done with the selected products, and the process presented a good probability of success as evaluated by ARKEMA in the middle of the project period. The elaboration of the commercial plan did not present a problem for those in the industrial sector. The case was very different for the academic partners. The deliverable of this task is a list of actions such as Market studies, Toxicology Studies, Preparation of Communication Documents, Customer Visits, Preparation of samples.... as well as associated costs. In the future, these tasks need better collaboration with business schools.

Generally, the partners that responded to the questionnaire designed to prepare the commercial plan gave a matching answer concerning the prospective successful products, as required. These are namely Soabe (castor oil), Nykomb (H_2 for H_2O_2), PDC (CPD Services), and Arkema (Technical Polymer, Hydrogen Peroxide).

Concerning the necessary budget, out of the five partners that responded to the questionnaire, only two of them put the total budget they require (Arkema and Soabe), a partner partially filled in the budget section (PDC), and for the remaining partners the budget had to be determined (Univ. Lille and Nykomb). For this latter, this inability to forecast the required budget can be explained by the fact that their product depends on another product, which is produced by a non-Eurobioref partner.

The budget is apportioned unevenly between the various posts according to their importance to the partners.

For partner 1, the “regulation-sales authorization-labels” receives the greatest amount followed by the posts related to marketing such as “marketing studies, sellers’ task force and formation and commercial strategies studies”. The posts concerning publicity and commercial mediums receive less amounts whereas the smallest of the budget is allocated to the commercial plan follow up and the logistic organization.

Partner 2 reserved their budget to only one post, the commercial strategies studies.

Finally, the budget required by each partner that filled in the funds section fluctuates between €500.000 and €1.520.000 with partner 1 requiring the largest amount for three products, representing €1.520.000, and partner 2 demanding €100000-500.000.

Further, note that many investors contacted the project for proposing support for the implementation of new technologies, which shows the large interest driven by the project results.

I.4.2. DISSEMINATION AND EXPLOITATION OF RESULTS

EuroBioRef was very active for disseminating its numerous results, and **more than 300 dissemination actions at various levels (academics, industrials, citizens, students…)** have been reported during the 4 years duration of the project. As the exploitation of the results in already discussed in the previous section, we concentrated here on the dissemination aspect. Note that many public information (film, video, leaflet, deliverables, slideshows, etc.) is available in our www.eurobioref.org website. Further, a **book ‘Biorefinery: From Biomass to Chemicals and Fuels’**, Ed. by Aresta, Michele / Dibenedetto, Angela / Dumeignil, Franck, ISBN: 978-3-11-026028-1’ is available (http://www.degruyter.com/view/product/177487) and will be followed end 2014 by a second book dedicated to students, notably in relation with the European Master Course that have recently been set by the partners. Further, EuroBioRef targeting many different communities with training events on biorefineries, LCA, separation techniques, etc… The training activities accomplished within EuroBioRef, were organized in four directions, namely, 1. Post graduate studies (MS, PhD) in topics relevant to the project, 2. Lectures for University courses and training material for various users, 3. Organization of workshops, training events and schools, and 4. Evaluation of the training.

EuroBioRef Summer School in Italy.

A large part of the EuroBioRef project was on advancing scientific knowledge on chemical and biochemical processes related with biorefinery, and a number of PhD and Master Theses were completed. In total **20 PhD theses** (13 completed, 7 to be completed) and **5 Master Theses** were defended at the academic partners' organisations.

EuroBioRef workshop on biomass cultivation in Poland.

Academic training included lectures on biorefinery topics in postgraduate programs. Eight courses of 20 h each were delivered by UCCS within two Master programs in the University of Lille 1. In addition, over 20 lectures in universities and schools on biorefinery-related subjects were presented by the academic partners.

Training for professionals included workshops for professionals, active in the biorefinery and sustainable development sector. Three events were successfully organized. The training on "Life-Cycle Assessment of Biorefineries" was organised by PDC and Quantis on December 12-13, 2013. The workshop "Biomass cultivation for the production of chemicals and fuels organised by UWM together with CRES, SOABE & DTI on December 10, 2012, and two workshops "Energy and feed crops in Thrace" and "Perspectives for sustainable development of energy crops in Greece" targeting farmers and agricultural engineers were organised by CRES on January 10 and February 4, 2014, respectively.

Training for academic staff and students included the organization of two events. The first one on Reactive Molecular Separations was organized by TUDO from 13 to 15 November 2012, and the second on Biomass Gasification was organized by CERTH on January 28-29, 2014.

The EuroBioRef Summer School on "Utilization of Biomass for the Production of Chemicals or Fuels" was aimed at the effective training of young researchers from Academia and Staff from Industry on most up-to-date scientific and technological aspects of Biorefinery, and was organized by CIRCC on 18th-24th of September 2011 in Castro-Apulia, Italy. Important outcome of the Summer School was the publication of the lectures in a book published by De Gruyter. The book entitled "Biorefinery: From biomass to chemical and fuels" edited by M. Aresta, A. Dibenedetto and F. Dumeignil, was launched in August 2012.

All the training events were assessed by the participants. ALMA conducted a satisfaction survey, which was sent by email to participants soon after each training event. All participants (trainees and speakers) were invited to provide feedback on the training session. The comments were very positive for all the events.

I.4.2.1. EuroBioRef promotion

EUBIA, as the leader of this task was part of the Dissemination Discussion Group (DDG) hereafter referred to as the DDG of the 4 Biorefinery sister projects, which was created following the meeting of the 4 projects at the European Commission on 18th June 2010. The four projects selected under the FP7-Joint biorefinery Call in 2009 were Biocore, Suprabio, EuroBioRef and Star-Colibri. EUBIA has followed the work of the DDG since its creation by contributing to the elaboration of its scope and work plan and meeting the colleagues from the 4 sister projects. Eibhilin Manning (EUBIA) and Michele Aresta (CIRCC) participated in this DDG on behalf of EUBIA and EuroBioRef. EUBIA organised a Biorefinery networking event with the DDG on February 7th 2011 in Brussels attended by over 55 participants from industry, academic and policy sector, including ARKEMA, CIRCC, CRES, DTI, RWTH, CERTH, FEUP, ALMA, PDC and respresentatives. EuroBioRef first Press Conference was organised successfully connected to the 12M General Assembly. All the partners were involved into such **Project promotion** action, with a special leading role played by ARKEMA, CNRS-UCCS, EUBIA, CIRCC, ALMA. The **dissemination strategy** has been defined in Y1 and has been applied through the following years with success. It was continuously up-dated in order to adapt to face new realities. **Special care was put in Networking actions, notably with sister projects (Biocore, Suprabio, Star-Colibri) and in Harmonization actions (on LCA, economics, social, dissemination…) with the same projects. A number of common actions have been evaluated as Common Reports and exchange of information, which must take place on an absolute parithetic level.** For example, an Organization Committee was created with the aim of planning a Final Conference on February 2014 in which the results of the projects EuroBioRef, Suprabio and Biocore were shown to the industrial community, EU Commission Officers and policy makers (see the summary in section §I.4.2.5 below.

I.4.2.2. Dissemination to the scientific community

DTI took care of distributing the annual activity reports to scientific communities. The first 12 months activity report consisted in the brochure about the EuroBioRef project, which was distributed by E-mail correspondence to all major universities in the EU. Along with this communication, the first announcement of EuroBioRef summer school was attached. In addition, DTI planned to present, as a part of an oral presentation, the EuroBioRef project (the major outline); further, the EuroBioRef project brochure was distributed to all interested participants from the DTI exhibition stand at the 19th European Biomass Conference and Exhibition (19th EU BC&E) to held from 6 - 10 June 2011 at the ICC Berlin - International Congress Center Berlin – Germany.

EUBIA maintained the dissemination register and logged all dissemination actions of the consortium. The Dissemination Register was regularly updated and uploaded on Myndsphere (internal communication platform of the project). As a result, an impressive number of dissemination actions could be recorded, included oral and poster presentation in major bioeconomy-related events, for example.

As a whole, during the project life, 27 scientific papers in peer-reviewed scientific journals were published, and a lot more are in preparation. Regarding academic dissemination, EuroBioRef partners were involved in 20 PhD Thesis and 5 Master Thesis. 10+ university lectures were given, and a European Master Course has been designed and validated at Lille 1 university, which could start end 2014.

I.4.2.3. Dissemination to the industrial community

Like for the dissemination to the academic industry, dissemination to the industrial industry was extensive, with many events combining industrial and academic attendance, including EuroBioRef presentation in national and international events, and events especially designed by EuroBioRef, like many training events, or conferences, optionnaly involving the sister projects, especially for the final conference, which is described in §I.4.2.5 below.

I.4.2.4. Citizen awareness

Many dissemination actions were performed to reach the general public. We give here an overview of some of them

CNRS has realized a *ca.* **20 min film** on EuroBioRef that is available for large diffusion to the general public (end 2011). On July 2012, the website ChemistryViews.com, an authoritative voice within the scientific publication landscape, has published the EuroBioRef movie: http://www.chemistryviews.org/details/video/2100669/Introducing_the_EuroBioRef_Project.html

In addition to this video, EuroBioRef produce, at the end of the project, a 6 min video accompanied with a *ca.* 70 pages booklet both summarizing the outcomes of the project. All these documents are available on our websiste (www.eurobioref.org).

The **communication tool to the public** is the Web site of the Project www.eurobioref.org that contains the key info, including, for example, the teaching material used at the Summer School organized on September 18-24, 2011. This tool complements the **internal communication tool** that makes use of the tool www.myndsphere.com, which also contains all the non-public official documents of the Project.

Several lectures have been delivered in various occasions, organized by Universities or other institutions. EuroBioRef has largely contributed to workshops, delivering specialistic presentations or general lectures at Doctoral days, International General Conferences and Seminars. EuroBioRef was also presented in high schools, and even in a primary school in France, and in Street Science events, thus reaching a very general public.

Especially in Period 4, as many results were then available, EuroBioRef has intensified the contact with general media for the dissemination of EuroBioRef aims and objectives to the large public. EuroBioRef is in contact with the TV channel Euronews by the Series Producer of Futuris: http://fr.euronews.com/programmes/futuris/. Futuris has its own reportages and they have 47 planned for 2014, to start to be produced in December 2013. They saw the website and the video and they are really keen on doing reportage on this project. Further, EuroBioRef was presented, *e.g.*, by the National TV Channel Direct 8 in February 2014 in the 'Le Grand 8' programme.

A press conference has been organized during the first day of the 48M GA. 9 French journalists attended this successful press conference during which Franck Dumeignil / CNRS-UCCs and Jean-Luc Dubois / ARKEMA presented the results of the EurobioRef project. Many articles (to date more than 30) have been published online and in the press, from both local (*e.g.*, la Voix du Nord, and

French national newspapers, *e.g.*, Le Figaro, Les Echos, etc., as well as European Media). A press book will be gathered afterwards and communicated to the European Commission.

Furthermore the media agency Cohn & Wolfe, working alongside Michael Jennings, Martina Daly and Agata Stasiak from the DG Research and Innovation of the European Commission is selecting EU-funded projects that we feel have the potential for pan-European media outreach (distribution across the 28 Member States). The EuroBioRef project is one of the stories they are currently considering to benefit from this support, which will help boost EuroBioRef profile with both various stakeholders and with the European media. The Commission has mandated Cohn & Wolfe to target, *i.e.*, top tier mainstream print, online, broadcast and social media. The stories selected will be disseminated in the first semester of 2014.

I.4.2.5. Intermediate workshop & final seminar

The intermediate workshop was organized at the mid time in the project inviting external experts in the course of the European Biomass Conference to discuss the project objectives and results obtained until this period and to benefit from potentially new research results. This workshop permitted to receive direct feedback regarding their current research activities and to consider them in the project. It was successfully held during the 20th European Biomass Conference and Exhibition in Milan, Italy, on June 20, 2012 20th European Biomass Conference & Exhibition. The workshop actually took place 2 pm on Tuesday 19th of June 2012 with the title: **EuroBioRef workshop: Prospects for Biorefineries.** During the event the speakers Myrshini Chirstou (CRES), Klaus Neumann (Borregard) and Kyriakos Panopoulos (CERTH), presented the participants works and results carried out in the EuroBioRef Project. Before the oral session, Myrsini Christou provided an exhaustive introduction, where the whole EuroBioRef concept was shown to the participants. With 53 participants, attendants included Industries, Public Authorities, Universities and research center. The variety of the audience was indeed one of the main objectives of this event. The academic prominence in attendance was naturally directly related to the research-nature of the project and its attraction towards researchers and PhDs.

First row, from left to right: Mrs Maria Georgiadou (Research Programme Officer, EC DG Research & Innovation), Mr Rudolf Strohmeier (RTD/Deputy Director-General Research Programmes, EC). **Second row, from left to right:** Mr Michael O'Donohue (BIOCORE coordinator), Mr Franck Dumeignil (EuroBioRef coordinator), Mr Ashok Bhattacharya (SUPRABIO coordinator).

The **final seminar** was set as a common event was organized in Brussels on the 11th-12th of February 2014 to communicate the so-obtained results and to discuss the wider implications of these for tomorrow's biorefineries. This was a real success, with more than 250 participants and lively discussions. The conference *'Tomorrow's Biorefineries in Europe'* was held at Hotel Le Plaza, Brussels on 11th-12th of February 2014, and was organised as two back-to-back events:

1. **Day 1 – Shaping policies for advanced biorefineries (11th February 2014)** - Dedicated to policy factors influencing biorefinery commercialisation, this event targeted policymakers and non-governmental agencies and related stakeholders;
2. **Day 2 – Technologies for advanced biorefineries (12th February 2014)** - Dedicated to presentations on the exploitation of results and to a brokerage event. This second day targeted industrial players and stakeholders groups that are involved in the later stages of technology development and transfer.

In particular, Day 2 targeted industrial players and other groups interested by technology take-up issues. During this event, delegates were first provided with an overview of the aims and achievements of BIOCORE, EuroBioRef and SUPRABIO, followed by the opportunity to attend a ½ day technology exhibition and a partnering session. The format of the technology exhibition, which was composed of short oral presentations, visits to exhibition stands and poster presentations, was designed to offer delegates with a dynamic and varied networking experience that put emphasis on exchanges between project participants and the conference delegates, either in the more open context of the exhibition hall, or in the framework of appointments in the 1-to-1 partnering room. The day 2 conference brought together participants of the three projects with European industrial players

(SMEs and multinationals) and technology transfer specialists active in the fields of bioenergy, bioproducts and biorefinering. More information available on the website https://colloque.inra.fr/eubiorefineryprojectsfinalconf.

Industry was also targeted. The Conference presentations were complementary, highlighting showcases and specifically giving attention to success stories / Technical achievements / Exploitable results.

The audience was mainly focused on *(i)* Industrial stakeholders or *industrialists* (large industries, SMEs, trade bodies, etc.); *(ii)* Political stakeholders or *officials* (EC, Permanent Representation representatives; *(iii)* Capital providers; *(iv)* Selected academic stakeholders or *scientists* (from universities, research institutes, etc.); and *(v)* Selected expertise and/or interest in the field of biomass, bioenergy, biorefinery, catalysis and related areas, including other biorefinery initiatives (projects, platforms, networks).

Specifically concerning EuroBioRef, the innovation developed within the project was presented through the 5 Value Chains plus two other oral presentations in which the hydrolysis of cellulose and the cofermentation of glycerol and hydrolystaes to afford either *n*-butanol and *1,3*-propanediol or *1,3*-propanediol and probiotic biomass was discussed. The choice was made to present the EuroBioRef results per value chain rather than per technology, in order to show how an efficient collaboration between partners can lead to innovative results. The success stories were presented in a brochure with a collection of Innovative Technologies, distributed to the participants.

I.5. Consortium and contact information

Coordinator

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Partners

1. CNRS, Centre National de la Recherche Scientifique (UMR8181, UMR5256, UMR6509) France
2. ARKEMA FRANCE SA /CECA, France – jean-luc.dubois@arkema.com
3. BORREGAARD Industries. Ltd., Norway
4. NOVOZYMES A/S, Denmark
5. *Partner 5 left the project without contributing and was replaced by partners 29 and 30 below*
6. CRES, Center for Renewable Energy Sources, Greece
7. HALDOR TOPSØE A/S, Denmark
8. CERTH, Centre for Research & Technology Hellas, Greece
9. PDC, Process Design Center BV, the Netherlands
10. QUANTIS, Switzerland
11. EUBIA, European Biomass Industry Association, Belgium
12. DTI, Danish Technological Institute, Centre for Renewable Energy and Transport, Denmark
13. Technische Universität Dortmund, Germany
14. MERCK KGaA, Germany
15. FEUP Faculdade de Engenharia da Universidade do Porto, Portugal
16. RWTH Aachen, Germany – *retired from the project on 31/08/2011*
17. CIRCC, University of Bari, Italy
18. WSK "PZL-Rzeszow" S.A, Poland
19. OBRPR, Ośrodek Badawczo-Rozwojowy Przemysłu Rafineryjnego Spółka Akcyjna, Poland
20. SINTEF Materials and Chemistry, Norway
21. SOABE, Société Agricole de Befandriana-Sud & Partners Sarl, Madagascar
22. UMICORE AG & Co KG, Germany
23. Nykomb Synergetics AB, Sweden
24. Alma Consulting Group SAS, France
25. Ruse Chemicals AD, Bulgaria – *demerger from Orgachim AD, Bulgaria from 1st January 2014*
26. Imperial College of Science, United Kingdom
27. Novance, France
28. University of Warmia and Mazury in Olsztyn, Poland
29. Technische Universität Hamburg – Hamburg, Germany – *entered the project from M24*
30. BKW Biokraftwerke Fürstenwalde GmbH, Germany – *entered the project from M24*

Acknowledgements

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II Use and dissemination of foreground

II.1. Section A: Dissemination (Public)

II.1.1.List of scientific (peer-reviewed) publications (A1) - Public

Template A1: List of scientific (peer reviewed) publications, starting with the most important ones											
No	**SP / WP**	**Title**	**Main authors**	**Title of the periodical or the series**	**Number, date or frequency**	**Publisher**	**Place of publication**	**Date of publication**	**Relevant pages**	**Permanent identifiers** (if available)**	**Is/Will open access*** provided to this publication ?**
1	WP5.6	A new process for the valorisation of a Bio-alcohol: the oxidehydration of 1-butanol into maleic anhydride	Caldarelli, A. ; Cavani, F. ; Garone, O. ; Pavarelli, G. ; Dubois, J.-L. ; Mitsova, I. ; Simeonova, L.	Tagungsbericht- dgmk deutsche wissenschaftliche gesellschaft fur erdol, erdgas und kohle	3	DGMK	Hamburg, Germany	02/10/2012	Pages 145-152		No
2	WP 4.2 , WP 7.3	Improved n-butanol production by a non-acetone producing Clostridium pasteurianum DSMZ 525 in mixed substrate fermentation	W. Sabra, C. Groeger, P.N. Sharma, and A.-P. Zeng	Applied Microbiology and Biotechnology	In press	Springer Verlag	Germany	02/03/2014	In press		Yes

3	WP5.1	Ammoniation-dehydration of fatty acids into nitriles: heterogeneous or homogeneous catalysis ?	Adrien Mekki-Berrada , Simona Bennici , Jean-Philippe Gillet , Jean-Luc Couturier , Jean-Luc Dubois , Aline Auroux	ChemSusChem.	Vol 6, Issue 8	Wiley-VCH Verlag	Germany	01/08/2013	Pages 1478-1489		Yes
4		Rhodium-Catalyzed Tandem Isomerization/Hydroformylation of the Bio-Sourced 10-Undecenenitrile: Selective and Productive Catalysts for Production of Polyamide-12 Precursor	Jérémy Ternel, Jean-Luc Couturier, Jean-Luc Dubois, Jean-François Carpentier	Advanced Synthesis & Catalysis	Vol 355, Issue 16	Wiley-VCH Verlag	Germany	11/11/2013	Pages 3191–3204		
5	SP6, WP6.3	Investigation of K-promoted Cu-Zn-Al, Cu-X-Al and Cu-Zn-X (X=Cr, Mn) catalysts for carbon monoxide hydrogenation to higher alcohols	E. Heracleousa, E.T. Liakakoua, A.A. Lappasa, A.A. Lemonidou	Applied Catalysis A: General	Vol 455	Elsevier	Netherlands	30/03/2013	Pages 145–154		Yes

6	WP5.4.4	Ammoxidation of allyl alcohol – a new sustainable route to acrylonitrile	Cyrille Guillon, Carsten Liebig, Sébastien Paul, Anne-Sophie Mamede, Wolfgang F. Hölderich, Franck Dumeignil and Benjamin Katryniok	Green Chemistry	Vol 15 / Issue 11	Royal Society of Chemistry	UK	01/11/2013	Pages 3015-3019		
7		Catalytic Synthesis of Hydroxymethyl-2-oxazolidinones from Glycerol or Glycerol Carbonate and Urea	Dibenedetto A, Nocito F, Angelini A, Papai I, Aresta M, Mancuso R	ChemSusChem	Vol 6, Issue 2	Wiley-VCH Verlag		01/02/2013	Pages 345-352		Yes
8		Glycerol Valorization as Biofuel: Thermodynamic and Kinetic Study of the Acetalization of Glycerol with Acetaldehyde	Rui P. V. Faria , Carla S. M. Pereira , Viviana M. T. M. Silva , José M. Loureiro , and Alírio E. Rodrigues	Industrial and Engineering Chemistry Research	Vol 52, Issue 4	American Chemical Society		09/01/2013	Pages 1538–1547		Yes

9	SP5/WP 5.4	Converting wastes into value added products: from glycerol to glycerol-carbonate, glycidol and epichlorohydrin using environmentally friendly synthetic routes.	Angela Dibenedetto , Antonella Angelini , Michele Aresta , Jayashree Ethiraj , Carlo Fragale , Francesco Nocito	Tetrahedron	Volume 67, Issue 6,	Elsevier Limited	London, UK	11/02/2011	Pages 1308-1313	Yes	Yes
10	WP 5.2	Selective oxidation of ethanol towards high valuable products over industrial and model catalysts	Kaew-arpha Thavornprasert, UCCS-CNRS; Béatrice de la Goublaye de Ménorval, Mickaël Capron, Julien Gornay, Louise Jalowiecki-Duhamel, Xavier Sécordel, Sylvain Cristol, Jean-Luc Dubois, and Franck	Biofuels	Vol. 3, No. 1	Future Science Group	London, UK	01/01/2012	Pages 25-34	Yes	Yes

			Dumeignil								
11	WP 4.2	Recovery of n-butanol using ionic liquid-based pervaporation membranes	S. Heitmann , J. Krings , P. Kreis , A. Lennert , W.R. Pitner , A. Górak , M.M. Schulte	Separation and Purification Technology	Vol 97	Elsevier	Netherlands	03/09/2012	Pages 108–114	Yes	Yes
12	WP 5.2.4	Green Fuel Production Using the PermSMBR Technology	Carla S. M. Pereira , Viviana M. T. M. Silva , Alírio E. Rodrigues	Industrial and Engineering Chemistry Research	Vol 51 / Issue 26	American Chemical Society	United States	04/07/2012	Pages 8928–8938	Yes	No
13	SP3, SP8 (but mainly results obtained outside EuroBio Ref)	History and future of world's most advanced biorefinery in operation	Gudbrand Rødsrud , Martin Lersch , Anders Sjöde	Biomass and Bioenergy	Vol. 46	Elsevier Limited	London, UK	01/11/2012	Pages 46-59		
14	WP4.2	Extraction of 1,3-Propanediol from Aqueous Solutions Using Different Ionic Liquid-Based Aqueous Two-	Anja Müller , Andrzej Górak	Separation and Purification Technology	Vol 97	Elsevier	Netherlands	01/09/2012	Pages 130–136		No

		Phase Systems									
15	SP.7/Sp. 8	Integrated processing for the separation of biobutanol. Part A: experimental investigation and process modelling	Stoffers, M.; Heitmann, S.; Lutze, P.; Gorak, A.	Green Processing and Synthesis	Vol 2, Issue 2	De Gruyter	Germany	01/01/2013	Pages 101–120		No
16	WP5.2.4	Glycerol valorisation as biofuels: Selection of a suitable solvent for an innovative process for the synthesis of GEA	Rui P. V. Faria , Carla S. M. Pereira , Viviana M. T. M. Silva , José M. Loureiro , and Alírio E. Rodrigues	Chemical Engineering Journal	Vol 233	Elsevier	Netherlands	01/11/2013	Pages 159–167	Yes	Yes
17		Highly productive iron molybdate mixed oxides and their relevant catalytic properties for direct synthesis of 1,1-dimethoxymethane from methanol	Kaew-arpha Thavornprasert a, Mickaël Capron, Louise Jalowiecki-Duhamela, Olivier Gardolla, Martine Trentesauxa, Anne-Sophie Mamedea, Ge	Applied Catalysis B: Environmental	Vol 145	Elsevier		08/02/2013	Pages 126–135		Yes

			Fanga, Jérémy Fayea, Nadia Touatia, Hervé Vezina, Jean-Luc Duboisd, Jean-Luc Couturier, Franck Dumeignil								
18		Plant design aspects of catalytic biosyngas conversion to higher alcohols	K. Atsonios , Ch. Christodoulou , E.-I. Koytsoumpa , K.D. Panopoulos , Em. Kakaras	Biomass and Bioenergy	Vol 53	Elsevier Limited	UK	01/06/2013	Pages 54-64		
19		Experimental Solid–Liquid Phase Equilibria of a Methyl Ester/Amide/Nitrile Ternary System by DSC	A. Mekki-Berrada, S. Bennici, J.-L. Dubois, A. Auroux	Journal of the American Oil Chemists' Society	Vol. 90 / Issue 11	Springer Verlag	Germany	01/11/2013	Pages 1621-1627		No
20	SP.7	Continuous multi-stage extraction of n-butanol from aqueous solutions	Martin Stoffers, Andrzej	Separation and Purification	Vol 120	Elsevier	Netherlands	01/12/2013	Pages 415-422		No

		with 1-hexyl-3-methylimidazolium tetracyanoborate	Górak	Technology							
21	SP2	Production costs and residues evaluation of Crambe abyssinica as an energy feedstock	Mariusz Stolarski, Michał Krzyżaniak, Malwina Śnieg, Myrsini Christou, Efthimia Alexopoulou	Environmental Biotechnology	Vol 9, Issue 2	University of Warmia and Mazury in Olsztyn		01/12/2013	In print		Yes
22	SP2	Life cycle assessment of Crambe abyssinica production for an integrated multi-product biorefinery	Mariusz Stolarski, Michał Krzyżaniak, Malwina Śnieg, Myrsini Christou, Efthimia Alexopoulou	Environmental Biotechnology	Vol 9, Issue 2	University of Warmia and Mazury in Olsztyn		01/12/2013	In print		Yes
23	SP5/WP 5.5	Semicontinuous distillation of impurities for the production of butyl acrylate from bio-butanol and bio-acrylic acid	Alexander Niesbach, Thomas A. Adams II, Philip Lutze	Chemical Engineering and Processing	Vol 74	Elsevier	Netherlands	01/12/2013	Pages 165–177		No

24	WP 4.2	Experimental investigation of pervaporation membranes for biobutanol separation	Sebastian Heitmann, Vera Krüger, Daniel Welz, Philip Lutze	Journal of Membrane and Separation Technology	Vol 2	Lifescience Global	Mississauga, ON, Canada	30/11/2013	Pages 245-262		Yes
25		Agglomeration problems during cardoon fluidized bed gasification	Christos Christodoulou, Efthymia-Ioanna Koytsoumpa, Kyriakos D. Panopoulos, Sotiris Karellas, Emmanouil Kakaras	Thermal Science	Issue 00	Vinča Institute of Nuclear Sciences	Belgrade, Serbia	22/09/2013	Pages: 132-132		
26	WP5.1	Fatty acid methyl esters into nitriles: acid-base properties for enhanced catalysts.	A. Mekki-Berrada , S. Bennici , J.P. Gillet , J.L. Couturier , J.L. Dubois , A. Auroux	Journal of Catalysis	Vol 306	Academic Press Inc.	United States	01/10/2013	Pages 30–37		Yes
27		Glycerol conversion to acrylonitrile by consecutive dehydration over WO3/TiO2 and ammoxidation	Carsten Liebig, Sébastien Paul, Benjamin Katryniok,	Applied Catalysis B: Environmental	Vol 132-133	Elsevier	Netherlands	27/03/2013	Pages 170– 182		Yes

		over Sb-(Fe,V)-O	Cyrille Guillon, Jean-Luc Couturier, Jean-Luc Dubois, Franck Dumeignil, Wolfgang F. Hoelderichb								
28	WP5.1	Design of amphoteric mixed oxides of zinc and IIIA elements (Al, Ga, In): migration effects on basic features	A. Mekki-Berrada, D. Grondin, S. Bennici, A. Auroux	Physical Chemistry Chemical Physics	Vol 14, Issue 12	Royal Society of Chemistry	UK	28/03/2012	Pages 4155-4161		Yes
29	WP5.2.4	Coupled PermSMBR - Process Design and Development for 1,1-Dibutoxyethane Production	C.S.M. Pereira, V.M.T.M. Silva and A.E. Rodrigues	Chemical Engineering Research and Design	In press	Institution of Chemical Engineers	UK	28/11/2013	In press		Yes
30	WP 4.2	Experimental and theoretical investigation of multistage extraction of 1,3-propanediol using the extraction system phosphate/1-butyl-3-	Anja Müller, Philip Lutze, Andrzej Gorak	Biotechnology Progress	Vol 29, Issue 4	John Wiley and Sons Ltd	UK	01/07/2013	Pages 933–942		No

		methylimidazolium trifluoromethanesulfonate/water									
31	WP 4.2	Integrated processing for the separation of biobutanol: Experimental investigation, modelling and process anaysis	Sebastian Heitmann , Martin Stoffers , Philip Lutze	Green Processing and Synthesis	Vol 2, Issue 2	De Gruyter	Germany	01/01/2013	Pages 121–141		No
32	SP5/WP 5.5	Reactive distillation for production of n-butyl acrylate from bio-based raw materials	Alexander Niesbach, Philip Lutze, Andrzej Górak	Computer Aided Chemical Engineering	Vol 32	Elsevier	Netherlands	01/01/2013	Pages 223-228		No
33	WP4.2	Investigation of a phosphate/1-butyl-3-methylimidazolium trifluoromethanesulfonate/water system for the extraction of 1,3-propanediol from fermentation broth	Anja Müller, Robin Schulz, Julia Wittmann, Irene Kaplanow, Andrzej Gorak	RSC Advances	Vol 3, Issue 1	Royal Society of Chemistry	UK	31/10/2012	Pages 148-156		No

* A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
** Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

Currently, members of the consortium are working on several scientific (peer reviewed) joint publications. Regardless of project completion, the consortium expects that the dissemination of results will continue and joint papers are expected to be published in the following months. Below, a preliminary list of some of the manuscripts currently under preparation is described (not included on the EC portal):

No	SP / WP	Title	Main authors	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Permanent identifiers** (if available)	Is/Will open access*** provided to this publication ?
1		Willow productivity on a commercial plantation located in north-eastern Poland	M. J. Stolarski, M. Krzyżaniak, S. Szczukowski, J. Tworkowski, and M. Śnieg	Canadian Journal of Plant Science	Submitted						
2		Economic efficiency of wood chips production from commercial plantation of new willow varieties (in Polish with English summary)	M. J. Stolarski, M. Krzyżaniak, S. Szczukowski, J. Tworkowski, and M. Śnieg	Roczniki Ekonomii Rolnictwa I Rozwoju Obszarów Wiejskich	Submitted						
3		Comparing calcined and un-treated olivine as bed materials for tar reduction in Fluidized Bed gasification	Christos Christodoulou , Dimitris Grimekis, Kyriakos D. Panopoulos; Eleni P Pachatouridou, Eleni F	Applied Catalysis B: Environmental	Submitted	Elsevier	The Netherlands				

			Iliopoulou, Emmanouil Kakaras								
4		Ruthenium catalyzed ethenolysis of renewable oleonitrile	J. Bidange, J.-L.Dubois, J.-L. Couturier, Fischmeister, C. Bruneau	ChemSusChem	To be submitted	Wiley-VCH Verlag					
5		Performance Evaluation of Silica Membrane for Water–*n*-Butanol Binary	Panagiotis Boutikos, Carla S.M. Pereira, Viviana M.T.M. Silva, Alirio E. Rodrigues	Separation and Purification Technology Journal	To be submitted	Elsevier	The Netherlands				
6		Willow biomass energy generation efficiency and CO_2 emission reduction potential	Mariusz J. Stolarski, Michał Krzyżaniak, Józef Tworkowski, Stefan Szczukowski, Malwina Śnieg	Renewable Energy	Submitted - In review		Renewable Energy				
7		Energy intensity and energy ratios in producing willow chips as feedstock for an integrated biorefinery	Mariusz J. Stolarski, Michał Krzyżaniak, Józef Tworkowski, Stefan Szczukowski, Janusz Gołaszewski	Biosystems Enginerring	Submitted - In review		Biosystems Enginerring				

8		Willow biomass as feedstock for an integrated multi-product biorefinery	Michał Krzyżaniak, Mariusz J. Stolarski, Bogusława Waliszewska, Stefan Szczukowski, Józef Tworkowski, Dariusz Załuski, Malwina Śnieg	Industrial Crops and Products	Submitted - In review		Industrial Crops and Products				
		Synthesis, characterization and catalytic activity of binary and ternary oxides in the trans-esterification of dimet hylcarbonate with phenol	Angela Dibenedetto, Antonella Angelini, Luigi di Bitonto, Elvira De Giglio, Stefania Cometa, and Michele Aresta								

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Template A1: List of Project Publications (Thesis/Dissertation)							
No	**SP / WP**	**Title**	**Authors**	**Date of approval**	**Institution Name**	**Institution Location**	**Is/Will open access*** provided to this publication?**
1	WP5.2	Production of acetals from bio-resources alcohols over bifunctional catalysts	UCCS-CNRS	14/03/2013	Universite Lille 1 – sciences et technologies	Villeneuve d'Ascq, France	
2	WP5.3	Synthesis of higher alcohols from ethanol over hydroxyapatite-based catalysts	UCCS-CNRS	20/02/2013	Universite Lille 1 – sciences et technologies	Villeneuve d'Ascq, France	
3		A new process for the synthesis of maleic anhydride by means of 1-butanol selective oxidehydration	Master Thesis by Giovanni Brunetto (CIRCC)	01/02/2013	Industrial Chemistry, University of Bologna	Bologna, Italy	
4		1-butanol as an alternative reagent for the production of maleic anhydride	CIRCC	29/02/2012	University of Bologna, Italy	Bologna, Italy	
5		Production of acetal from bio-resources alcohols over bifunctional catalysts	UCCS-CNRS	14/03/2013	Universite Lille 1 – sciences et technologies	Villeneuve d'Ascq, France	
6		Synthesis of higher alcohols from ethanol over hydroxyapatite - based catalysts	UCCS-CNRS	27/02/2013	Universite Lille 1 – sciences et technologies	Villeneuve d'Ascq, France	
7		Supported molybdenum and tungsten based catalysts for the direct synthesis of methylmercaptan from syngas	UCCS-CNRS	24/05/2013	Universite Lille 1 – sciences et technologies	Villeneuve d'Ascq, France	
8		Glycerol valorisation as biofuels: Glycerol acetal production by Simulated Moving Bed Reactor	FEUP	28/02/2014	Faculty of Engineering of the University of Porto	Porto, Portugal	

9	WP5.1	Catalyseurs homogènes et hétérogènes à base de ruthénium pour la métathèse d'oléfines issues de bio-ressources	UCCS-CNRS	22/02/2013	Universite Lille 1 – sciences et technologies	Villeneuve d'Ascq, France	
10	WP5.1	Immobilization of metathesis catalysts on mesoporous materials for the conversion of biosourced fatty compounds	UCCS-CNRS and RWTH Aachen	20/12/2012	Universite Lille 1 – sciences et technologies	Villeneuve d'Ascq, France	
11	WP6.3	Etude de la promotion des catalyseurs CuZnAl pour la production d'alcools supérieurs à partir du biosyngaz	UCCS-CNRS	20/12/2013	Ecole Centrale de Lille	Villeneuve d'Ascq, France	
12	WP5.6	Studio sulla reazione di disidratazione catalitica di 1-butanolo	CIRCC	08/03/2013	University of Bologna	Bologna, Italy	
13	WP5.1	Production of fatty nitriles by direct reaction with ammonia: design of catalysts for operating at lower temperature	CNRS IRCELYON	19/04/2013	University of Lyon	Villeurbanne , France	
14	WP 4.2 , WP 7.3	Improved n-butanol production by a non-acetone producing Clostridium pasteurianum DSMZ 525 in mixed substrate fermentation	TUHH	30/12/2015	TU Hamburg-Harburg	Hamburg, Germany	
15	WP 4.2 , WP 7.3	Coproduction of n-butanol and 1,3-propanediol by Clostridium pasteurianum in mixed substrate fermentation	TUHH	30/12/2015	TU Hamburg-Harburg	Hamburg, Germany	
16	WP 4.2 , WP 7.3	Microbial production of 1,3-propanediol from gylcerol and biomass hydrolysate	TUHH	01/12/2015	TU Hamburg-Harburg	Hamburg, Germany	
17	WP 4.2 , WP 7.3	Metabolic flux analysis for the characterization of microbial product strains	TUHH	01/08/2014	TU Hamburg-Harburg	Hamburg, Germany	
18	WP 4.2 , WP 7.3	Development of a fast sampling and treatment system for metabolic characterization of	TUHH	01/12/2014	TU Hamburg-Harburg	Hamburg, Germany	

		microbial product strains					
19		Mixed oxides tunable agents for C-O and C-N bond breaking and C-O bond formation	Luigi di Bitonto - CIRCC	28/03/2014	Bari University	Bari, IT	

II.1.2.List of dissemination actions (A2) - Public

Template A2: List of dissemination activities									
No	**SP / WP and (if applicable) result number**	**Type of activities***	**Main leader**	**Title/ Subject/ Reference**	**Actual/ planned date or status**	**Place**	**Type of audience****	**Size of audience**	**Countries addressed**
1	SP10 / WP10.2	Press Release	CIRCC	Designing the Next Generation Bio-Refinery: The EuroBioRef Project	01/04/2010	La Chimica e l'Industria, official Journal of the Italian Chemical Society,	Scientific Community (higher education, Research), Industry	5000	Italy
2	SP10 / WP10.2	Press Release	BORREGAARD	Designer moergendagens bioreffineri	02/03/2010	local and national press + research, industry and bio media	Medias	40	Norway
3	SP10 / WP10.2	Publication	UCCS-CNRS	EuroBioRef: Projet PCRD7 de grande envergure	01/03/2010	http://www.univ-lille-nord-de-france.fr/recherche-innovation/Actu.html	Scientific Community (higher education, Research)	1000	France
4	SP10 / WP10.2	Press Release	UCCS-CNRS	Communiqué de presse EuroBioRef	01/03/2010	http://www.ec-lille.fr/1267449776327/0/fiche___actualite/	Scientific Community (higher education, Research), Industry	1000	France
5	SP10 / WP10.2	Press Release	UCCS-CNRS	Elaboration de la prochaine génération de bio-raffineries: Le projet EuroBioRef	01/03/2010	Press Release http://www.ensc-lille.fr/act341-elaboration-dune-bio-raffinerie.html	Scientific Community (higher education, Research), Industry	1000	France

6	SP10 / WP10.2	Website/Applications	UCCS-CNRS	Designing the Next Generation Bio-Refinery: The EuroBioRef Project	01/03/2010	http://eurobioref.org/	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1000	EU & International
7	SP10 / WP10.2	Press Release	UCCS-CNRS	La Lettre du CNRS en délégation / Dernière publication sur EuroBioRef - DR18 / Email	22/01/2010	UCCS-CNRS	Scientific Community (higher education, Research), Industry, Civil Society	1000	France
8	SP10 / WP10.2	Publication	UCCS-CNRS	Optimising the European Bio-Refinery Processes / General presentation of EuroBioRef	20/01/2010	Projects, British Publishers, January 2010	Scientific Community (higher education, Research), Industry	1000	EU + International
9	SP10/WP10.2	Publication	UCCS-CNRS	Vient de paraître - Dernière publication sur EuroBioRef	22/01/2010	DR18 CNRS-Hebdo Nord Pas-de-Calais et Picardie édition du 22.01.2010	Scientific Community (higher education, Research)	1000	International
10	SP10 / WP10.2	Publication	UCCS-CNRS	L'UCCS coordonne l'élaboration de la prochaine génération de bio-raffineries: le projet EuroBioRef	01/03/2010	http://uccs.univ-lille1.fr/spip.php?article290	Scientific Community (higher education, Research), Industry	1000	International
11	SP10 / WP10.2	Press Release	UCCS-CNRS	2.1 Nouvelles de France 2.1.1 EuroBioRef / Mailing	05/03/2010	SCF Flash info et SCF Info en ligne 2010, N° 05	Scientific Community (higher education,	1000	France

							Research), Industry, Medias		
12	SP10 / WP10.2	Press Release	ARKEMA	Arkema partner in EuroBioRef and BIOCORE projects in the transformation of biomass (bio-refining)	01/03/2010	Press&Arkema Website communication	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1000	International
13	SP10 / WP10.2	Publication	UCCS-CNRS	10 ans au Service des Chercheurs	30/03/2009	J'innove en Nord Pas de Calais - Le Magazine, Number 2 p15, September 2009	Scientific Community (higher education, Research)	500	France
14	SP10 / WP10.2	Website/Applications	UCCS-CNRS	EuroBioRef	03/03/2010	http://www.societechimiquedefrance.fr/fr/eurobioref.html	Scientific Community (higher education, Research)	1000	France
15	SP10 / WP10.2	Press Release	CERTH	"Designing the Next Generation Bio-Refinery: The EuroBioRef Project"	01/03/2010	www.certh.gr and www.lignite.gr	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	500	Greece
16	SP10 / WP10.2	Press Release	EUBIA	Designing the Next Generation Bio-Refinery: The EuroBioRef Project	01/03/2010	www.eubia.org	Industry, Civil Society, Policy makers, Medias	1000	EU + International
17	SP10 / WP10.2	Press Release/	Orgachim	Designing the Next Generation Bio-Refinery: The EuroBioRef	01/03/2010	www.orgachim.bg & www.extrinews.bg	Industry, Medias	1000	Bulgaria

		Web Release		Project					
18	SP10 / WP10.2	Press Release	SOABE	EuroBioRef	01/03/2010	Express de Madagascar	Civil Society, Medias	1000	Madegascar
19	SP10 / WP10.2	Press Release	HTAS	Design af næste generations bio-raffinaderi: - om EuroBioRef projektet	01/03/2010	Press Contacts, Denmark	Medias	100	Denmark
20	SP10 / WP10.2	Press Release	Umicore	Ausgestaltung des europaischen BioraffinerieKonzepts der nachsten Generation: EuroBioRef	01/03/2010	Umicore Website and contacts	Industry, Medias	1000	International
21	SP10 / WP10.2	Press Release	SINTEF	Next Generation biorefinery	01/03/2010	SINTEF contacts	Scientific Community (higher education, Research), Industry, Medias	1000	Scandanavia
22	SP10 / WP10.2	Press Release	Faculdade de Engenharia da Universidade do Porto	FEUP integra projecto europeu	01/03/2010	FEUP contacts	Scientific Community (higher education, Research)	1000	Portugal
23	SP10 / WP10.2	Articles published in the popular press	Umicore	EuroBioRef Project to build biorefinery of the future	01/03/2010	Speciality Chemicals Magazine March 2010 Vol 30 No 3	Scientific Community (higher education, Research), Industry	1000	EU
24	SP10 / WP10.2	Poster	PDC	EuroBioRef – A New European Bio-Refinery Project	03/05/2010	18th European Biomass Conference and Exhibition, Lyon, (France)/ Subject 4, Subsection 4.4	Scientific Community (higher education, Research), Industry, Civil	2000	EU + International

							Society, Policy makers, Medias		
25	SP10 / WP10.2	Publication	EUBIA	EUBIA Projects - EUROBIOREF	19/04/2010	EUBIA March - April Newsletter	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1000	EU + International
26	SP10 / WP10.2	Posters	PDC	EuroBioRef – A New European Bio-Refinery Project	07/06/2010	RRB6 - the 6th International Conference on Renewable Resources and Biorefineries - Dusseldorf, Germany	Scientific Community (higher education, Research), Industry	1000	EU + International
27	SP10 / WP10.2	Presentation	UCCS-CNRS	Valorisation de la Biomasse : Catalyse & 'Bio-Raffineries', l'Exemple du Concept EuroBioRef	17/05/2010	Réunion 2010 du groupe d'Etude en Catalyse Porquerolles, France	Scientific Community (higher education, Research)	100	France
28	SP10 / WP10.2	Presentation	UCCS-CNRS	Franck Dumeignil "On the Role of Catalysis in Integrated Concepts of Biorefineries"	12/07/2010	Bilateral Indo-French Symposium 'Catalysis for Sustainable and Environmental Chemistry', Pune, India	Scientific Community (higher education, Research), Industry, Policy makers	500	International
29	SP10 / WP10.2	Presentation	UCCS-CNRS	"The Next Generation of Integrated Bio-Refineries: The EuroBioRef Concept"	20/10/2010	Europa Bio's European Forum for Industrial Biotechnology 2010 ('EFIB 2010'), Edinburgh, Scotland	Scientific Community (higher education, Research), Industry, Policy makers,	500	EU

							Medias		
30	SP10 / WP10.2	Presentation	UCCS-CNRS	"Integrated Concepts of Biorefineries: The EuroBioRef Model"	22/10/2010	Frontiers in Heterogeneous Catalysis, Garching (Germany)	Scientific Community (higher education, Research)	100	German + International
31	SP10 / WP10.2	Publication	UCCS-CNRS	L'Ecole Centrale de Lille Participe au Projet EuroBioRef	30/03/2010	Le Journal d'Informations de l'Ecole Centrale de Lille, Number 455	Scientific Community (higher education, Research), Medias	1000	France
32	SP10 / WP10.2	Publication	UCCS-CNRS	Designinning the next generation biorefineries	01/07/2010	Specialty Chemicals Magazine	Scientific Community (higher education, Research), Industry	1000	International
33	SP10/WP10.2	Poster	UCCS-CNRS	Organometallic Catalysis: An Important Technology Embedded in a Novel Biorefinery Concept	19/07/2010	24th International Conference on Organometallic Chemistry, Tapei , Taiwan	Scientific Community (higher education, Research), Industry	1000	International
34	SP10/WP10.2	Presentation	UCCS-CNRS	Nouveaux Concepts de Bio-Raffineries : Des Fiançailles entre Biotech et Catalyse Chimique vers un Mariage?	27/10/2010	Colloque Innovations en Chimie du Végétal, Paris, France	Scientific Community (higher education, Research)	100	France
35	SP10/WP10.2	Presentation	UCCS-CNRS	Next Generation Biorefineries & Catalysis	27/10/2010	Conférence invitée organisée par la Royal Society of Chemistry of Belgium, Tervuren, Belgium	Civil Society	100	Belgium
36	SP10/WP10.3	Presentation	UCCS-CNRS	La catalyse au cœur des bioraffineries du futur	31/01/2011	Master 'CEE' (Chemistry Energy Environment). 20h of lecture, Lille,	Scientific Community (higher	100	France

						France	education, Research)		
37	SP10/WP10.2	Interviews	UCCS-CNRS	Franck Dumeignil speaks about EuroBioRef on 'Radio Campus' - Radio interview	24/11/2010	Program 'Lille 1 info'	Scientific Community (higher education, Research), Civil Society	1000	France
38	SP10/WP10.2	Presentation	UCCS-CNRS	'EuroBioRef : Expectations Toward Star-Colibri'	28/10/2010	Meeting of the Star-Colibri Reference Group, Brussels	Scientific Community (higher education, Research), Industry	20	EU
39	SP10/WP10.2	Presentation	UCCS-CNRS	Biorefineries & Catalysis	10/01/2011	Workshop State Key Laboratory of Physical Chemistry of Solid Surfaces of Xiamen University, China	Scientific Community (higher education, Research), Industry	100	International
40	SP10/WP10.2	Presentation	UCCS-CNRS	Catalysis in biorefineres	09/01/2011	Workshop State Key Laboratory of Physical Chemistry of Solid Surfaces of Xiamen University, China	Scientific Community (higher education, Research)	100	International
41	SP10/WP10.3	Presentation	UCCS-CNRS	Impact des carburants Bilan environnemental des différentes filières énergétiques pour les applications mobiles, amélioration des carburants et biocarburants	01/02/2011	Master CEE' (Chemistry Energy Environment). 16h.	Scientific Community (higher education, Research)	100	France
42	SP10/WP10.2	Publication	UCCS-CNRS	Développement durable - Bio-raffineries du futur	01/12/2010	Article in the Journal du CNRS	Scientific Community (higher education, Research)	1000	France
43	SP10/WP1	Publication	UCCS-	Sustainable development - Bio-	01/12/2010	Article in the Journal du	Scientific	500	Internation

	0.2		CNRS	Refineries of the Future		CNRS	Community (higher education, Research)		al
44	SP6, WP6.3	Publication	CERTH	Thermodynamic and experimental investigation of the effect of operating conditions on the catalytic thermochemical production of higher alcohols from 1biosyngas	19/05/2011	8th Panhellenic Chemical Engineering Conference, Thessaloniki, Greece	Scientific Community (higher education, Research), Industry	500	Greece
45	SP10/WP1 0.2	Presentation	UCCS-CNRS	Outline of the EuroBioRef Project	19/01/2011	Lille, France	Scientific Community (higher education, Research), Industry	100	France
46	SP10/WP1 0.2	Website/Applications	UCCS-CNRS	Eurobioref Project Online Banner	01/12/2010	Public Affairs	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	EU
47	SP5/WP 5.2	Presentation	UCCS-CNRS	Abstract & Poster Presentation	06/06/2011	19th European Biomass conference and exhibition	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	2000	Germany & EU
48	SP5/WP.5.3	Presentation	UCCS-CNRS	Abstract	28/08/2011	EuropaCat X, Glasgow, Scotland	Scientific Community (higher	500	EU

							education, Research), Industry		
49	SP10/WP10.2	Poster	UCCS-CNRS	Vegetal Chemistry', 'Biomasse et Chimie'	27/01/2011	Public Event - International Year of Chemistry	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	France
50	SP10/WP10.2	Poster	UCCS-CNRS	'Vegetal Chemistry', 'L'UCCS Leader pour la Création d'une Bioraffinnerie'	27/01/2011	Public Event - International Year of Chemistry	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	France
51	SP10/WP10.2	Presentation	UCCS-CNRS	Outline of the EuroBioRef Project" (Invited lecture)	12/04/2011	European Expert Forum on Biorefineries, Budapest, Hungary	Scientific Community (higher education, Research), Industry	150	EU
52	SP10/WP10.2	Presentation	UCCS-CNRS	“The Next Generation of Biorefineries & Catalysis” (Invited seminar)	28/06/2011	Seminar at the Rheinisch-Westfälische Technische Hochschule (‘RWTH’) Aachen, Germany	Scientific Community (higher education, Research)	200	Germany
53	SP10/WP10.2	Publication	UCCS-CNRS	“Bio-Refineries of the Future” ‘Sustainable Development’	10/01/2011	CNRS International Magazine, n°20, p41 Quarterly	Scientific Community (higher education, Research),	5000	International

							Industry, Civil Society, Policy makers, Medias		
54	SP10/WP10.3	Publication	UCCS-CNRS	Bioraffinerie du Futur	04/02/2011	Année Internationale de la Chimie, 'Les Chimistes s'Invitent au Lycée', Lycée Saint Adrien, Villeneuve d'Ascq, France	Civil Society	100	France
55	SP10/WP10.2	Presentation	UCCS-CNRS	Standard_Set of Slides for Eurobioref Consortium	01/02/2011	www.eurobioref.org	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	EU
56	SP10/WP10.2	Organisation of workshops	UCCS-CNRS	Biorefinery Networking Event - Outline of the EuroBioRef Project	07/02/2011	Reneable Energy House, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers	60	EU
57	SP10/WP10.2	Publication	UCCS-CNRS	The Next Generation of Biorefineries	01/03/2011	Public Service Magazine	Scientific Community (higher education, Research), Industry, Civil Society	5000	International
58	SP5/WP5.2	Presentation	FEUP	Catalysis in Multiphase Reactors CAMURE-8	22/05/2011	International Symposium on Multifunctional Reactors ISMR-7,	Scientific Community (higher	500	EU

						Naantali, Finland	education, Research), Industry		
59	SP10/WP10.2	Publication	UCCS-CNRS	Hailing the hybrid, turning the spotlight onto a new golden age of catalysis…	01/09/2011	Public Service Magazine	Scientific Community (higher education, Research), Industry	5000	International
60	SP10/WP10.2	Publication	UCCS-CNRS	EuroBioRef Logo	01/03/2011	Public Service Magazine Cover	Scientific Community (higher education, Research), Industry	5000	International
61	SP10/WP10.3	Presentation	UCCS-CNRS	'Eco-conception : une démarche responsable' course: 'Biomasse, Bioraffineries & Catalyse'	08/03/2011	Ecole Centrale de Lille, 2nd year students, Villeneuve d'Acsq	Civil Society	100	France
62	SP10/WP10.2	Publication	UCCS-CNRS	Les Bioraffineries du Futur - Des chimistes dans la société (Invited lecture)	31/05/2011	Cité des sciences et de l'industrie de la Villette, Paris, France	Scientific Community (higher education, Research)	500	France
63	SP10/WP10.2	Publication	UCCS/CNRS	Biomass, page 2	02/05/2010	Valbiomag, Belgium	Scientific Community (higher education, Research), Industry	1000	Belgium
64	SP10/WP10.2	Publication	UCCS/CNRS	EU pumps €23m into biorefinery project	23/04/2010	Engineering&Technology, Vol 5, Issue 5, p13	Scientific Community (higher education, Research), Industry	5000	International
65	SP10/WP10.2	Publication	UCCS/CN	"Des Bioraffineries Zéro Déchet" - 'Développement durable'	01/02/2011	CNRS / Le Journal, n°252-253, p36	Scientific Community	5000	France

			RS				(higher education, Research), Industry		
66	SP10/WP10.2	Presentation	UCCS/CNRS	Outline of the EuroBioRef Project (Invited conference)	28/03/2011	Chinese-French Symposium on Bioresources and CO2 Valorisation, Fudan University, Shanghai	Scientific Community (higher education, Research), Industry	100	International
67	SP10/WP10.2	Presentation	UCCS/CNRS	Biomass, Catalysis & Next Gen Biorefineries (Invited lecture)	13/06/2011	4th Symposium of the French-TaiwaneseProgramme « Frontiers of Science », Nice, France	Scientific Community (higher education, Research), Industry	100	France &Taiwan
68	SP10 / WP10.2 / D10.2.4	Website/Applications	UCCS/CNRS	Website launch	01/12/2010	http://www.eurobioref.org/	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	International
69	WP 5.2	Poster	UCCS/CNRS	Highly efficient MoO3-Fe2(MoO4)3 catalyst' for the production of 1,1-dimethoxymethane and 1,1-diethoxyethane from bio-sourced alcohols (poster and presentation)	01/10/2011	First International Congress on Catalysis for Biorefineries (CatBior), Torremolinos-Málaga, Spain	Scientific Community (higher education, Research), Industry	1000	EU
70	SP10	Presentation	CIRCC	Catalysis for Biomass Conversion, Biotechnological reduction of CO2 to methanol in water (Invited lecture)	28/06/2010	St Petersbourg, Russia	Scientific Community (higher education, Research)	300	International

71	SP10	Presentation	CIRCC	Application of the Biorefinery concept to aquatic biomass (Invited keynote)	24/07/2010	iBIO Congress, Dalian, China	Scientific Community (higher education, Research)	500	International
72	SP10	Flyers	UCCS/CNRS	Elaboration d'une Bio-Raffinerie (leaflet)	20/01/2011	North of France Regional Council advertisement - Européenne pour un Traitement Durable de la Biomasse.	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	France
73	SP10/WP10.2	Publication	UCCS/CNRS	Collaboration Picks Up Speed - Industry and academia pull together harder - Biorefinery Project'	01/05/2010	Chemical Processing, Volume 73, Issue 5, p20-24	Scientific Community (higher education, Research), Industry	5000	International
74	SP2/WP2.2.3	Poster	DTI	Tool for modeling cost, energy consumption and CO2-footprint for multiple biomass feedstock logistics into a bio-refinery	10/06/2011	19th European Biomass Conference and Exhibition, Berlin, Germany	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	2000	EU
75	SP4/WP 4.2	Presentation	TUDO	Abstract for conference(poster or oral presentation)	07/09/2011	1st International Conference on Ionic Liquids in Separation and Purification Technology	Scientific Community (higher education, Research)	500	International
76	SP/WP 4.2	Presentation	TUDO	Abstract for conference(poster or oral presentation)	03/10/2011	XIX International Solvent Extraction Conference	Scientific Community (higher	200	EU

							education, Research)		
77	SP10	Press release	ALMA	Le projet EuroBioRef: 23M€ de l'Europe pour élaborer une bio-raffinerie intégrée!	01/06/2011	Lettre du Financement de l'innovation, France Press	Medias	100	France
78	SP10	Poster	PDC	EuroBioRef	07/06/2010	Conference Proceedings RRB6 - 6th International Conference on Renewable Resources and Biorefineries, Düsseldorf, Germany	Scientific Community (higher education, Research), Industry	500	International
79	SP10	Presentation	PDC	EuroBioRef	28/10/2010	Fachtagung Nachhaltige Biokraftstoffe, Gelsenkirchen, Germany	Scientific Community (higher education, Research), Industry	75	Germany
80	SP10	Presentation	PDC	EuroBioRef	15/02/2011	Bio-raffiniert VI, Oberhausen, Germany	Scientific Community (higher education, Research), Industry	150	Germany
81	SP10	Publication	ALMA	EuroBioRef leaflet	01/02/2011	http://www.eurobioref.org	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	International
82	SP10	Poster	PDC	EuroBioRef	05/05/2011	Official Conference Proceedings, 18th European Biomass Conference & Exhibition	Scientific Community (higher education, Research),	2000	International

							Industry, Civil Society, Policy makers, Medias		
83	SP10/WP10.2	Presentation	UCCS/CNRS	“Bioraffinerie du Futur”	05/03/2011	Année Internationale de la Chimie, ‘Si on parlait Chimie!’, CERLA, 5th of March, Villeneuve d’Ascq, France	Scientific Community (higher education, Research)	100	France
84	SP10 / WP10.2	Presentation	UCCS/CNRS	"Química Sostenible" (lecture in the frame of ERASMUS/SOCRATESStaff Mobility)	14/03/2011	Escuela Universitaria de Engenieros Tecnico e Industrial de Terrassa Universidad Politécnica de Cataluña TERRASSA (BARCELONA) SPAIN	Scientific Community (higher education, Research)	25	Spain
85	SP10/WP10.2	Articles published in the popular press	UCCS/CNRS	Breathing life into European Biomass	01/02/2012	Projects Magazine	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1000	International
86	SP10 / WP10.2	Presentation	UCCS/CNRS	‘Bioressources et Bioraffinerie de Demain’	30/05/2011	Colloque Scientifique Interdisciplinaire de l’Institut Universitaire de France: « Les ressources », Lyon, France	Scientific Community (higher education, Research), Industry	100	France
87	SP10/WP10.2	Articles published in the popular press	UCCS/CNRS	Vie de la recherche	25/03/2011	CNRS-Hebdo Nord Pas-de-Calais et Picardie	Scientific Community (higher education, Research), Industry	1000	International

88	SP10/WP10.2	Articles published in the popular press	UCCS/CNRS	“White Biotech or Industrial Biotech”	30/03/2011	GoingPublic Magazin, Supplement White Biotechnology 2011, n°2, p16-19	Scientific Community (higher education, Research), Industry	5000	International
89	SP10/WP10.2	Presentation	UCCS/CNRS	"Biofuels and and Perspectives of Hydrotreating and Hydrocracking Technologies" (Invited keynote)	28/08/2011	7th International Symposium on Hydrotreating / Hydrocracking Technologies, Denver CO, USA	Scientific Community (higher education, Research), Industry	5000	International
90	SP10/WP10.2	Presentation	UCCS/CNRS	UCCS: Leader of the EuroBioRef Project, Leader of the WP3 of PIVERT; Competencies & Expectations (Invited lecture)	24/05/2011	4th British-French Workshop Platform molecules & Biomass Green Chemistry, York, UK	Scientific Community (higher education, Research), Industry	100	EU
91	SP10/WP10.2	Video	UCCS/CNRS	Bioressources et Bioraffinerie de Demain (Invited lecture)	30/05/2011	Colloque Scientifique Interdisciplinaire de l’Institut Universitaire de France: « Les ressources », Lyon, France	Scientific Community (higher education, Research), Industry	200	France
92	SP10/WP10.2	Presentation	UCCS/CNRS	Biorefineries, Biofuels & Chemicals (Invited lecture)	14/11/2011	2nd International Conference on Green & Sustainable Chemistry, ‘ICGSC11’, Biopolis, Singapore	Scientific Community (higher education, Research), Industry	200	International
93	SP10/WP10.2	Presentation	UCCS/CNRS	"The Central Role of Catalysis in Next Generation Biorefineries" (Invited Lecture)	12/09/2011	National Meeting of the Italian Chemical Society, Lecce-Castro, Italie	Scientific Community (higher education, Research),	500	International

							Industry		
94	WP 5.2	Publication	UCCS/CNRS	Highly effective FeMo catalyst for the selective acetalization of biomass-derived alcohols	17/06/2011	Taminco Green Footsteps Awards and Event, Belgium	Scientific (higher education, Research), Industry	100	EU
95	WP 5.3	Poster	UCCS/CNRS	Effective FeMo catalyst for the selective acetalization of biomass-derived alcohols	19/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific Community (higher education, Research)	100	EU
96	SP10 / WP10.2 / D10.2.4	Publication	ALMA	Standard_Set of Slides for Eurobioref Consortium Version 2	16/03/2011	General Assembly, Paris, France	Scientific (higher education, Research), Industry	120	EU
97	SP10 / WP10.2 / D10.2.4	Press release	ALMA	Press Release - EuroBioRef	17/03/2011	General Assembly, Paris, France	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1000	International
98	SP6, WP6.3	Poster	CERTH	Synthesis of higher alcohols from syngas over K-promoted CuZnAl catalysts	29/08/2011	EuropaCat X, Glasgow, Scotland	Scientific (higher education, Research), Industry	500	EU
99	WP 5.1.1	Presentation	CNRS-IRCELYON	Development of catalysts for production of fatty nitriles at low temperature	29/08/2011	EuropaCat X, Glasgow, Scotland	Scientific (higher education, Research), Industry	500	EU
100	WP6.3.1	Poster	UCCS/CNRS	Supported Mo-based catalysts for the upgrading of biosyngas to	18/09/2011	EuroBioRef Summer School, Lecce-Castro,	Scientific Community	100	EU

				MeSH		Italy	(higher education, Research)		
101	SP10/WP10.2	Presentation	UCCS-CNRS	UCCS: Leader of the EuroBioRef Project; Competencies of the VAALBIO team (Invited Seminar)	06/06/2011	National Chemichal Laboratory, Associated International Laboratory NCL-UCCS, Pune, India	Scientific Community (higher education, Research)	100	India
102	SP10/WP10.2	Presentation	UCCS-CNRS	Next Generation Biorefineries: Producing Chemicals & Fuels without any Waste" (Invited Conference)	19/10/2011	Environmental Biotechnology-2011 (WCEB-2011), Dalian, China	Scientific (higher education, Research), Industry	500	International
103	WP 5.2	Poster	UCCS-CNRS	Effective FeMo catalyst for the selective acetalization of bioalcohols	12/12/2011	A Green Chemistry for Industry (GCI), Lille, France	Scientific (higher education, Research), Industry	150	EU
104	SP10/WP10.3	Presentation	UCCS-CNRS	La catalyse au cœur des bioraffineries du futur	01/09/2011	Master 'CEE' (Chemistry Energy Environment). 20h of lecture, Lille, France	Scientific Community (higher education, Research)	100	France
105	SP10/WP10.3	Presentation	UCCS-CNRS	Impact des carburants Bilan environnemental des différentes filières énergétiques pour les applications mobiles, amélioration des carburants et biocarburants	05/09/2011	Master 'CEE' (Chemistry Energy Environment). 16h of lecture, Lille, France	Scientific Community (higher education, Research)	100	France
106	SP1	Presentation	ARKEMA	Refinery of the furute: Feedstock, Processes, Products	20/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific (higher education, Research)	60	EU
107	WP 5.1.1	Poster	CNRS-IRCELYON	Characterization and development of catalysts for the synthesis of fatty nitriles at low temperature	23/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific (higher education, Research)	60	EU

108	SP3, SP8 (but mainly results obtained outside EuroBioRef)	Presentation	BORREGAARD	Conversion of cellulose, hemicellulose and lignin into platform molecules: Biotechnlogical approach	21/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific (higher education, Research)	60	EU
109	SP2	Poster	UWM	Willow cultivation technology and biomass utilisation in Poland	19/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific (higher education, Research)	60	EU
110	WP5.2.4	Poster	FEUP	PermSMBR - A new hybrid technology: application on a green fuel production	19/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific (higher education, Research)	60	EU
111	SP10/WP10.2	Presentation	CIRCC	Outline of the EuroBioRef Project	26/05/2011	Green Week, European Commission, Brussels, Belgium	Civil Society, Policy makers, Medias	250	EU
112	SP10/WP10.2	Publication	UCCS-CNRS	Biorefineries & Biofuels in the EU – Perspectives and Hurdles (Invited Conference)	05/10/2011	Committee of the regions, Open Days, 9th European Week of Regions and Cities, Brussels, Belgium	Civil Society, Policy makers, Medias	100	EU
113	SP10/WP10.2	Presentation	UCCS-CNRS	Biomasse, Chimie et Bioraffineries du Futur (Invited Conference)	28/10/2011	Shennong Forum, Alliance Française, Shanghai, China	Scientific (higher education, Research), Industry	100	China
114	SP10/WP10.2	Presentation	UCCS-CNRS	Next Generation Biorefineries: The EuroBioRef Concept (Invited Lecture)	14/02/2012	DECHEMA biannual conference, Frankfurt, Germany	Scientific (higher education, Research), Industry	500	EU
115	SP10/WP10.2	Presentation	UCCS-CNRS	Bioraffinerie & Catalyse du Futur (Invited Conference)	24/10/2011	Ecole Normale Supérieure de Paris, Paris, France	Scientific (higher education, Research)	50	France

116	SP10/WP10.2	Presentation	UCCS-CNRS	Activités de l'Equipe Valorisation des Alcanes et des Composés Issus de la Biomasse' de l'UCCS (Invited Seminar)	24/10/2011	Laboratoire de Réactivité de Surface, UMR CNRS 7197, Ivry, France	Scientific (higher education, Research)	50	France
117	SP10/WP10.2	Exhibitions	UCCS-CNRS	Stand 5 : Chimie durable, du Végétal et chimie verte ou « de l'or noir à l'or vert »	13/10/2011	Public Event FÊTE DE LA SCIENCE 2011- Village des Sciences de la métropole Lilloise, Lille France	Scientific (higher education, Research), Civil Society	1000	France
118	SP10/WP10.2	Presentation	UCCS-CNRS	Biomass, Chemistry and Next Generation Biorefineries (Invited Conference)	01/11/2011	Shennong Forum, University of Forestry, Dalian, China	Scientific (higher education, Research)	100	China
119	SP10/WP10.2	Film	UCCS-CNRS	Molecules from Sunshine: The Refinery of the Future	01/11/2011	Open diffusion, Copyright CNRS Images 2011, Directed by Marcel Dalaise, CNRS	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	5000	International
120	SP10/WP10.2	Presentation	UCCS-CNRS	Biomasses, Chemistry and biorefineries of the future (Invited Conference)	13/03/2012	Ecole Centrale de Lille, Villeneuve d'Ascq, France	Scientific (higher education, Research)	100	France
121	SP10/WP10.2	Interview	UCCS-CNRS	Synfuels production shifting from petroleum to biomass	21/10/2011	Engineering News	Scientific Community (higher education, Research), Industry, Civil Society, Medias	800	International
122	SP10/WP10.2	Presentation	DTI	Chemicals from biomass for future materials and energy	09/06/2011	19th European Biomass Conference and	Scientific (higher	1500	International

						Exhibition, Berlin	education, Research), Industry		
123	SP10/WP10.2	Interview	UCCS-CNRS	Industrial Biotechnology	01/03/2012	Going Public, Special issue	Scientific Community (higher education, Research), Industry, Medias	1000	International
124	SP10/WP10.2	Presentation	UCCS-CNRS	From Sun to Molecules, the Biorefinery of the Future (Film projection and debate)	23/01/2012	CNRS Headquarters, Paris	Scientific (higher education, Research)	50	France
125	SP10/WP10.2	Presentation	UCCS-CNRS	Biomasses, chimie et bioraffineries du futur (Invited conference) (Film projection and debate)	02/04/2012	CNRS Headquarters, Semaine du Développement Durable, Paris, France	Scientific Community (higher education, Research), Civil Society	150	France
126	SP10/WP10.2	Exhibitions	UCCS-CNRS	EuroBioRef Film Projection on UCCS-CNRS booth	19/11/2011	Lille Grand Palais, 'Salon des formations supérieures et de la recherche', Lille, France	Scientific Community (higher education, Research), Civil Society	2000	France
127	WP 5.3	Poster	UCCS-CNRS	Studies on structural, textural and acid-base properties of Ca and Sr hydroxyapatitesmodified with alkali metal/CO32	20/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific Community (higher education, Research), Industry	60	EU
128	SP3, SP8 (but mainly results obtained outside	Presentation	BORREGAARD	Biorefinery at Borregard -Recent Developments	11/10/2011	Second International Conference on Lignocellulosic Ethanol, Verona, Italy	Scientific Community (higher education, Research),	150	International

	EuroBioRef)						Industry		
129	SP6, WP6.3	Poster	CERTH	Synthesis of higher alcohols from syngas over K-promoted CuZnAl catalysts	19/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific Community (higher education, Research), Industry	60	EU
130	SP6, WP6.3	Presentation	CERTH	Investigation of Cu/X/Al and Cu/Zn/X (X=Cr, Mn) mixed oxides for alcohol synthesis from biosyngas	09/12/2011	21st Panhellenic Chemistry Conference, Thessaloniki, Greece	Scientific Community (higher education, Research), Industry	60	Greece
131	WP 4.2	Presentation	TUDO	Extraktion von 1,3-Propandiol aus wässrigen Lösungen mittels wässriger Zweiphasensysteme auf Basis	10/04/2012	Jahrestreffen Clausthal-Zellerfeld, Germany	Scientific Community (higher education, Research), Industry	100	Germany
132	SP6/WP6.3 .1	Poster	UCCS-CNRS	Conversion of biosyngas to MeSH over supported Mo-based catalysts	02/07/2012	15th International Congress on Catalysis, Munich, Germany	Scientific Community (higher education, Research), Industry	500	International
133	WP 4.2	Presentation	TUDO	Extraction of 1,3-Propanediol Using Im4,1 CF3SO3 in an Ionic Liquid-Based Aqueous Two-Phase System	05/08/2012	EUCHEM Conference on Molten Salts and Ionic Liquids, Wales, UK	Scientific Community (higher education, Research)	100	International
134	SP6, WP6.3	Presentation	CERTH	Investigation of K-promoted Cu/X/Al and Cu/Zn/X (X=Cr, Mn) mixed oxides for higher alcohol synthesis from biosyngas	02/07/2012	15th International Congress on Catalysis, Munich, Germany	Scientific Community (higher education, Research), Industry	500	International

135	WP 5.1.1	Presentation	CNRS-IRCELYON	Catalytic conversion of fatty acids into nitriles in liquid and gas phase : bifunctional catalysts evaluated by microcalorimetry	02/07/2012	15th International Congress on Catalysis, Munich, Germany	Scientific Community (higher education, Research), Industry	500	International
136		Presentation	UCCS-CNRS	Design of modified CuZnAl catalysts for higher alcohol synthesis	02/07/2012	15th International Congress on Catalysis, Munich, Germany	Scientific Community (higher education, Research), Industry	500	International
137	SP6/WP6.1	Poster	CERTH	Assessing the applicability of circulating fluidized bed gasification of five promising biomasses for energy production within a biorefinary: focus on agglomeration issues	18/06/2012	20th European Biomass Conference and Exhibition, Milano, Italy	Scientific Community (higher education, Research), Industry	1500	International
138	SP6, WP6.3	Poster	CERTH	Conversion of biomass syngas to higher alcohols: from lab scale experiments to plant design	18/06/2012	20th European Biomass Conference and Exhibition, Milano, Italy	Scientific Community (higher education, Research), Industry	1500	International
139	SP10/WP10.2	Poster	EUBIA	EuroBioRef -Outline of the first two years	19/06/2012	20th European Biomass Conference and Exhibition, Milano, Italy	Scientific Community (higher education, Research), Industry, Policy makers, Medias	1500	International
140	SP6/WP6.1	Poster	CERTH	Activated carbon's adsorption potential of tar species from syngas in warm conditions	20/06/2012	20th European Biomass Conference and Exhibition, Milano, Italy	Scientific Community (higher education, Research),	1500	International

							Industry		
141	WP5.1	Poster	CNRS RENNES	Valorization of renewable resources by olefin metathesis	07/03/2012	International Green Catalysis Symposium, Rennes, France	Scientific Community (higher education, Research)	120	EU
142	WP 5.3	Poster	UCCS-CNRS	Acid-base properties of carbonated hydroxyapatites modulated by morphology, Ca/P ratio and carbonate/sodium content	02/07/2012	15th International Congress on Catalysis, Munich, Germany	Scientific Community (higher education, Research), Industry	500	International
143	SP2	Presentation	UWM	Lignocellulosic biomass production and deliver for biorefineries	10/01/2012	Planetkongres - EuroBioRef Workshop , Denmark	Scientific Community (higher education, Research), Industry	100	EU
144	SP2	Presentation	CRES	Oil crops production and delivery for biorefineries	10/01/2012	Planetkongres - EuroBioRef Workshop , Denmark	Scientific Community (higher education, Research), Industry	100	EU
145	SP6	Poster	UCCS-CNRS	Nouveaux catalyseurs CuZnAl modifiés pour la synthèse d'alcools lourds	24/05/2012	GECAT, Morbihan, France	Scientific Community (higher education, Research)	100	France
146	SP3, SP8 (but mainly results obtained outside EuroBioRef)	Presentation	BORREGAARD	Biorefinery at Borregard -Recent Developments	14/02/2012	Dechema Biannual Conference, Frankfurt, Germany	Scientific Community (higher education, Research), Industry	500	EU

147	WP5.2.4	Presentation	FEUP	Glycerol valorisation as biofuels: selection of a suitable solvent for an innovative process for the synthesis of GEA	25/06/2012	ANQUE's International Congress of Chemical Engineering, Sevilla, Spain	Scientific Community (higher education, Research), Industry	500	EU
148	WP 5.1.1	Poster	CNRS-IRCELYON	One-pot without solvent conversion of fatty acids: medium's physical properties determination by DSC	26/06/2012	Calorimetry and Thermal Effects in Catalysis conference, Lyon, France	Scientific Community (higher education, Research)	200	International
149	SP10/WP10.2	Publication	EUBIA	Update of the EuroBioRef Project	12/03/2012	Suprabio Newsletter, UK	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1000	EU
150	WP 5.2	Poster	UCCS-CNRS	Highly selective iron molybdate catalyst for a one-pot synthesis of acetal DMM and study on its relevant properties	09/07/2012	CAT4BIO Conference, Advances in Catalysis for Biomass Valorization, Thessalonki, Greece	Scientific Community (higher education, Research), Industry	500	EU
151	WP 5.2	Poster	UCCS-CNRS	Why iron molybdate catalyst is so effective in direct conversion of methanol to dimethoxymethane ?	11/07/2012	2nd Bilateral Indo-French Symposium Conference, Villeneuve d'Ascq, Lille, France	Scientific Community (higher education, Research)	100	France
152	WP5.3	Poster	UCCS-CNRS	Guerbet reaction of ethanol over tailored hydroxyapatites	09/07/2012	CAT4BIO Conference, Advances in Catalysis for Biomass Valorization, Thessalonki, Greece	Scientific Community (higher education, Research), Industry	500	EU

153	WP5.3	Poster	UCCS-CNRS	Studies on structural and acid-base properties of Na+/CO32-modified hydroxyapatites	11/07/2012	2nd Bilateral Indo-French Symposium Conference, Villeneuve d'Ascq, Lille, France	Scientific Community (higher education, Research)	100	France
154	WP10.3	Organisation of workshops	UCCS-CNRS	EuroBioRef Summer School	01/12/2011	http://www.eurobioref.org/Summer_School/	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1000	International
155	SP6/WP6.3.1	Poster	UCCS-CNRS	Alumina and Silica supported Mo based catalysts for the one-step synthesis of MeSH using a syngas/H2S mixture	09/07/2012	CAT4BIO Conference, Advances in Catalysis for Biomass Valorization, Thessalonki, Greece	Scientific Community (higher education, Research), Industry	500	EU
156	SP10/WP10.2	Presentation	DTI	Overview of the EuroBioRef Project	13/07/2011	Biomass SP Project in Malysia Capacity Building Programme 4 on Success Stories of Biomass Conversion, Malaysia	Industry, Civil Society	50	Malaysia
157	SP10/WP10.2	Publication	UCCS-CNRS	New Concept of Biorefinery Comes into Operation: The EuroBioRef concept	02/07/2012	Chapter of EuroBioRef Book, DeGruyter Eds	Scientific Community (higher education, Research), Industry, Civil Society, Medias	5000	International
158	SP10/WP10.2	Publication	ARKEMA	Refinery of the Future: Feedstock, Processes, Products	02/07/2012	Chapter of EuroBioRef Book, DeGruyter Eds	Scientific Community (higher	5000	International

							education, Research), Industry, Civil Society, Medias		
159	WP 5,1,2	Poster	UCCS-CNRS	Heterogeneous Ruthenium Olefin Metathesis Catalysts for the Ethenolysis of Renewable Feedstocks	09/07/2012	CAT4BIO Conference, Advances in Catalysis for Biomass Valorization, Thessalonki, Greece	Scientific Community (higher education, Research), Industry	500	EU
160	SP10/WP10.2	Presentation	UCCS-CNRS	Concept of Biorefinery comes into operation: The Eurobioref project	19/09/2011	EuroBioRef Summer School, Lecce-Castro, Italy	Scientific (higher education, Research)	60	EU
161	WP 4.2	Presentation	TUDO	Jahrestreffen der Fachgruppe "Extraktion" und des Fachausschusses "Phytoextrakte - Produkte und Prozesse"	19/04/2012	Clausthal-Zellerfeld, Germany	Scientific (higher education, Research)	100	Germany & EU
162	WP5.1	Poster	CNRS RENNES	Valorization of renewable resources by olefin metathesis	09/07/2012	International Symposium on Homogeneous Catalysis, Toulouse, France	Scientific Community (higher education, Research), Industry	500	EU & Asia (China, India, Japan)
163	SP6/WP6.3.1	Poster	UCCS-CNRS	SynFuel/Promoted CuZn catalysts for higher alcohols production	26/06/2012	SynFuel2012 Symposium, Munich, Germany	Scientific Community (higher education, Research), Industry	200	EU
164	SP5.6	Presentation	CIRCC	A new process for the valorisation of a bio-alcohol: the oxidehydration of 1- butanol into maleic anhydride	08/10/2012	DGMK Conference, Berlin, Germany	Scientific (higher education, Research)	120	EU
165	SP6, WP6.3	Presentation	CERTH	Investigation of K-promoted Cu/X/Al and Cu/Zn/X (X=Cr, Mn)	01/07/2012	15th International Congress on Catalysis	Scientific Community	500	EU

				mixed oxides for higher alcohol synthesis from biosyngas		2012, Munich, Germany	(higher education, Research), Industry		
166	SP6, WP6.3	Oral presentation to a scientific event	CERTH	Investigation of K-promoted Cu/X/Al and Cu/Zn/X (X=Cr, Mn) mixed oxides for higher alcohol synthesis from biosyngas	08/07/2012	CAT4BIO Conference, 2012, Thessaloniki, Greece	Scientific Community (higher education, Research), Industry	500	International
167	SP6, WP6.3	Poster	CERTH	Thermochemical conversion of biosyngas to higher alcohols over K-promoted Cu/X/Al and Cu/Zn/X (X=Cr, Mn) catalysts	11/09/2012	EEFCATS Summer School 2012, Verbania, Italy	Scientific Community (higher education, Research), Industry	100	EU
168	"5.4.4"	Presentation	UCCS-CNRS	From glycerol to acrylonitrile by successive catalytic dehydration and ammoxidation	01/11/2012	UBIOCHEM III, Thessaloniki, Greece	Scientific Community (higher education, Research), Industry	200	EU
169	WP 4.2	Organisation of Conference	TUDO	Aufreinigung von 1,3-Propandiol mittels IL- basierter wässriger Zweiphasensysteme	10/09/2012	ProcessNet-Jahrestagung und 30. DECHEMA-Jahrestagung der Biotechnologen 2012, Karlsruhe, Germany	Scientific Community (higher education, Research)	100	Germany
170	WP5.2.4	Poster	FEUP	Glycerol valorization as biofuels: Selection of a suitable solvent for an innovative process for the synthesis of GEA	26/06/2012	ANQUE ICCE 2012, Sevilla, Spain	Scientific Community (higher education, Research, young researchers), Industry		EU, US & Japan
171	WP5.2.4	Presentation	FEUP	Glycerol valorization as biofuels	26/06/2012	ANQUE ICCE 2012,	Scientific		EU, US &

						Sevilla, Spain	Community (higher education, Research, young researchers), Industry		Japan
172	SP6/WP6.3 .1	Poster	UCCS-CNRS	Alumina and Silica supported Mo-based catalysts	08/07/2012	CAT4BIO Conference, 2012, Thessaloniki, Greece	Scientific Community (higher education, Research), Industry	500	International
173		Presentation	UCCS-CNRS	Efficient iron molybdate catalyst for a one-pot synthesis of dimethoxymethane	08/07/2012	CAT4BIO Conference, 2012, Thessaloniki, Greece	Scientific Community (higher education, Research), Industry	500	International
174	WP 4.2	Presentation	TUDO	Extraction of 1,3-propanediol in an ionic liquid-based aqueous two-phase system	05/08/2012	EUCHEM 2012, Celtic Manor, Wales, UK	Scientific Community (higher education, Research)		International
175	WP 4.2	Oral presentation to a scientific event	TUDO	Liquid-Liquid Extraction of 1-Butanol from Dilute Aqueous Solution Using Ionic Liquids	08/10/2012	DECHEMA Green Solvents for Synthesis, Boppard, Germany	Scientific Community (higher education, Research)		International
176	SP6, WP6.3	Oral presentation to a scientific event	CERTH	Hydrogenation of carbon monoxide to higher alcohols over modified CuZnAl catalysts	01/11/2012	UBIOCHEM III, Thessaloniki, Greece	Scientific Community (higher education, Research), Industry	500	International
177	WP5.6	Publication	TUDO	Reducing the C footprint of fuels and petrochemicals	08/10/2012	DGMK Conference, Berlin, Germany	Scientific Community	150	EU

							(higher education, Research), Industry		
178	SP5/WP5.5	Presentation	TUDO	Heterogeneously catalysed synthesis of *n*-butyl acrylate from bio-based *n*-butanol and acrylic acid using reactive distillation: impact of impurities	09/06/2012	ESCAPE-23, Lappeenranta, Finland	Scientific Community (higher education, Research)		EU
179	WP4.2	Poster	TUDO	Influencing the pervaporative recovery of n-butanol by using ionic liquids	23/09/2012	EuroMembrane 2012, London, Great Britain	Scientific Community (higher education, Research), Industry	200	International
180	WP4.2	Poster	TUDO	Gewinnung von n-Butanol mittels Pervaporationsmembranen auf Basis ionischer Flüssigkeiten	10/09/2012	ProcessNet-Jahrestagung und 30. DECHEMA-Jahrestagung der Biotechnologen 2012, Karlsruhe, Germany	Scientific Community (higher education, Research)	100	Germany
181	WP 4.2	Presentation	TUDO	Aufreinigung von 1,3-Propandiol mittels IL-basierter wässriger Zweiphasensysteme	11/09/2012	ProcessNet-Jahrestagung und 30. DECHEMA-Jahrestagung der Biotechnologen 2012, Karlsruhe, Germany	Scientific Community (higher education, Research)	100	Germany
182	WP 4.2	Publication	TUDO	Investigation of the phosphate / 1-butyl-3-methylimidazolium trifluoromethanesulfonate / water system for the extraction of 1,3-propanediol from fermentation broth	31/10/2012	http://pubs.rsc.org/en/content/articlelanding/2013/RA/c2ra22619g	Scientific Community (higher education, Research)		International
183	WP5.6	Presentation	CIRCC	A New Process for the Valorisation of a Bio-Alcohol: The Oxidehydration of 1-Butanol into Maleic Anhydride	10/10/2012	DGMK Conference, Berlin, Germany	Scientific Community (higher education,	150	EU

							Research), Industry		
184	WP 7.1	Presentation	PDC	Heuristic-numeric process synthesis for bio-based chemistries	21/04/2012	ECCE9 / ECAB2, The Hague, Netherlands	Scientific Community (higher education, research), Industry	100	International
185	WP 4.2	Presentation	TUDO	Liquid-Liquid Extraction of 1-Butanol from Dilute Aqueous Solution Using Ionic Liquids	09/10/2012	DECHEMA Green Solvents for Synthesis, Boppard, Germany	Scientific Community (higher education, Research)		International
186	WP5.2.4	Presentation	FEUP	Simulated Moving bed membrane Reactor - PermSMBR	12/11/2012	TuDelft Institute for Process Technology, Delft, Netherlands	Scientific Community (higher education, Research, young researchers), Industry		EU, US & Japan
187	Wp5,1	Poster	CNRS RENNES	Ethenolysis of Oleonitrile Catalyzed by Ruthenium Metathesis Complexes	21/05/2013	2nd International Symposium on Green Chemistry, La Rochelle, France	Scientific Community (higher education, Research, young researchers), Industry	500	EU & Asia (China, India, Japan)
188	SP5/WP5.5	Oral presentation to a scientific event	TUDO	Reactive distillation for production of n-butyl acrylate from bio-based raw materials	09/06/2013	ESCAPE 23 European Symposium on Computer Aided Process Engineering Lappeenranta, Finland	Scientific Community (higher education, Research)		EU
189	WP5.2.4	Publication	FEUP	Glycerol Valorisation as Biofuel: Thermodynamic and Kinetic	19/11/2012	I&CResearch - http://pubs.acs.org/doi/abs/10.1021/ie302935w	Scientific Community (higher		EU, US & Japan

				Study of the Acetalization of Glycerol with Acetaldehyde			education, Research, young researchers), Industry		
190		Presetation	DTI	Biomass logistics for Biorefineries	10/12/2012	Workshop: Biomass cultivation for the production of chemicals and fuels, Olsztyn, Poland	Scientific Community (higher education, Research, young researchers), Industry		EU
191		Publication	CERTH	Investigation of K-promoted catalysts for carbon monoxide hydrogenation to higher alcohols	15/02/2013	Elsevier - http://www.sciencedirect.com/science/article/pii/S0926860X1300077X	Scientific Community (higher education, Research, young researchers), Industry	1000	International
192	WP 4.2	Oral presentation to a scientific event	TUDO	Membrane-assisted downstream processing for biobutanol purification	28/04/2013	AIChE 2013 Spring Meeting, San Antonio, Texas	Scientific Community (higher education, Research)		International
193	WP 4.2	Oral presentation to a scientific event	TUDO	Pervaporation for Product Recovery from ABE Fermentations	12/05/2013	International Scientific Conference, Torun, Poland	Scientific Community (higher education, Research)		EU
194	SP 2	Oral presentation to a scientific event	UWM	Productivity and quality of biomass harvested from perennial energy crops in Poland	03/06/2013	21st EU BC&E, Copenhagen, Denmark	Scientific Community (higher education, Research), Industry, Civil		EU & US

							Society, Policy makers, Medias		
195		Oral presentation to a scientific event	CRES	Biomass feedstocks characterization for energy and biorefinery options	19/11/2012	International Conference on Biofuels for Sustainable Development of Southern Europe, Thessaloniki, Greece	Scientific Community (higher education, Research, young researchers), Industry		International
196		Presentation	CERTH	Biomass Gasification in Multilevel Integrated Biorefinery	18/10/2012	International Seminar on Gasification, Stockholm, Sweden	Scientific Community (higher education, Research, young researchers), Industry		EU
197		Publication	UCCS-CNRS	Toward the understanding of methanol acetalization to dimethoxymethane over a FeMo based catalyst	01/09/2013	11th European Congress on Catalysis – EuropaCat-XI, Lyon, France	Scientific Community (higher education, Research)		France & EU
198	SP6, WP6.3	Oral presentation to a scientific event	CRES	Biomass feedstocks for energy markets.	13/11/2012	IEA Bioenergy Conference, Vienna, Austria	Scientific Community (higher education, Research, young researchers), Industry		International
199	SP5.6	Oral presentation to a scientific event	CIRCC	Catalytic synthesis of 2-hydroxymethyl-oxazolidinones from glycerol carbonate or glycerol and urea	26/08/2012	4th EuCheMS Chemistry Congress, Prague, Czech Republic	Scientific community (higher education, Research)	2000	International

200	SP10	Publication	EUBIA	EUROpean multilevel integrated BIOREFinery design for sustainable biomass processing	01/06/2012	Be Sustainable - Special Issue http://issuu.com/besustainablemagazine/docs/be-sustainable_magazine	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International
201		Oral presentation to a wider public	ARKEMA	EuroBioRef: Lessons learned from a FP7 Biorefinery Project, from Crop to Product	24/04/2013	Innovation Excellence & NPD in the Process Industry, Barcelona, Spain	Industry		EU
202	WP 4.2	Oral presentation to a scientific event	TUDO	Membrane-Assisted Downstream Processing for Biobutanol Purification	01/05/2013	AIChE Spring Meeting, San Antonio, TX	Scientific community (higher education, Research)		International
203		Poster	DTI	Biomass logistics – a complex tool for optimizing cost, energy consumption and CO2-emissions	03/06/2013	21st European Biomass Conference and Exhibition (21st EU BC&E), Copenhagen, Denmark	Scientific Community (higher education, Research, young researchers), Industry		International
204		Poster	CERTH	Circulating fluidized bed gasification of 1st and 2nd generation biofuel seed cakes after oil extraction	03/06/2013	21st European Biomass Conference and Exhibition (21st EU BC&E), Copenhagen, Denmark	Scientific Community (higher education, Research, young researchers), Industry		International
205		Oral presentation to a	UCCS-CNRS	Optimisation de catalyseurs dédiés à la synthèse de thiocomposés : étude sur unité	05/07/2013	Journée Hall Pilote	Scientific community (higher		France

		scientific event		Pilote			education, Research)		
206	SP2	Oral presentation to a wider public	UWM	Life cycle assessment of Crambe abyssinica production for an integrated multi-product biorefinery	08/09/2013	The 4th International Environmental Best Practices Conference, Olsztyn, Poland	Scientific Community (higher education, Research), Industry		EU
207	SP2	Poster	UWM	Production costs and residues evaluation of Crambe abyssinica as an energy feedstock	08/09/2013	The 4th International Environmental Best Practices Conference, Olsztyn, Poland	Scientific Community (higher education, Research), Industry		EU
208	WP5.6	Oral presentation to a scientific event	CIRCC	Fossil hydrocarbons vs renewables for the synthesis of building blocks and intermediates: heterogeneous catalysis leads the way	01/09/2013	11th European Congress on Catalysis – EuropaCat-XI, Lyon, France	Scientific community (higher education, Research)	300	EU
209	SP5/WP5.5	Oral presentation to a scientific event	TUDO	Theoretical investigation of a semicontinuous distillation process for the separation of bio-based impurities	03/11/2013	AIChe Annual Meeting, San Francisco, US	Scientific community (higher education, Research)		EU & USA
210	WP5.1	Oral presentation to a scientific event	UCCS-CNRS	Ethenolysis of Oleonitrile Catalyzed by Ruthenium Metathesis Complexes	23/05/2013	International Symposium on Green Chemistry (ISCG2), La Rochelle, France	Scientific community (higher education, Research)		EU
211	WP 4.2	Oral presentation to a scientific event	TUDO	Membrane-Assisted Downstream Processing for Biobutanol Purification	03/11/2013	AIChe Annual Meeting, San Francisco, US	Scientific community (higher education, Research)		EU & USA
212		Oral presentation to a wider	ARKEMA	EuroBioRef: Lessons learned from a FP7 Biorefinery Project, from Crop to Product	13/09/2013	The 4th International Environmental Best Practices Conference,	Scientific Community (higher		EU

		public				Olsztyn, Poland	education, Research), Industry		
213		Oral presentation to a wider public	ARKEMA	New routes to biobased long chain polyamides from the EuroBioRef FP7 project	19/11/2013	Ecochem, International Conference & Exhibition on Sustainable Chemistry & Engineering. Basel, Switzerland	Scientific Community (higher education, Research), Industry		EU
214		Oral presentation to a scientific event	CNRS-IRCELYON	Biocarburants pour avion: De la production de nitriles gras à partir de biomasse non-comestible	26/06/2013	JSF, Villeurbanne, France	Scientific community (higher education, Research)		France
215	WP5.5	Poster	TUDO	Heterogeneously catalysed synthesis of n-butyl acrylate from bio-based n-butanol and acrylic acid using reactive distillation - impact of impurities	09/06/2013	ESCAPE 23 European Symposium on Computer Aided Process Engineering Lappeenranta, Finland	Scientific community (higher education, Research)		EU
216		Oral presentation to a wider public	CRES	Yield and biomass quality of selected oil crops produced for an integrated multi-product biorefinery	12/09/2013	The 4th International Environmental Best Practices Conference, Olsztyn, Poland	Scientific Community (higher education, Research), Industry		EU
217	SP10	Oral presentation to a wider public	UCCS-CNRS	Next Generation Biorefineries: EuroBioRef, an Integration of the Full Value Chain	12/09/2013	The 4th International Environmental Best Practices Conference, Olsztyn, Poland	Scientific Community (higher education, Research), Industry		EU
218		Poster	CRES	Comparison of several castor hybrids in Greece	12/10/2013	AAIC2013 - Washington D.C., US	Scientific community (higher education, Research)		International
219	SP10	Oral	UCCS-	Main Outcomes of the	19/11/2013	Plant Based Summit	Scientific	100	France

		presentation to a wider public	CNRS	EuroBioRef Project & Lessons Learned from an Academic Perspective (Invited Lecture)		'Shaping the Future with Plant Based Chemistry', Paris, France	community (higher education, Research) - Industry		
220		Oral presentation to a wider public	ARKEMA	A European Project supported within the Seventh Framework Programme for Research and Technological Development New Routes to BioBased long chain polyamides fromthe EuroBioRef FP7 project	19/11/2013	Ecochem, International Conference & Exhibition on Sustainable Chemistry & Engineering. Basel, Switzerland	Scientific community (higher education, Research), Industry		EU
221		Oral presentation to a wider public	QUANTIS	Life cycle assessment as a decision-making tool for biorefinery concepts: The case of FP7 EuroBioRef	19/11/2013	Ecochem, International Conference & Exhibition on Sustainable Chemistry & Engineering. Basel, Switzerland	Scientific community (higher education, Research), Industry		EU
222		Oral presentation to a wider public	Oral presentation to a wider public	High added value chemicals from non - edible biomass oil: low temperature catalysis	19/11/2013	Ecochem, International Conference & Exhibition on Sustainable Chemistry & Engineering. Basel, Switzerland	Scientific community (higher education, Research), Industry		EU
223	SP10	Oral presentation to a wider public	UCCS-CNRS	EuroBioRef Project (Invited Lecture)	30/10/2013	'FIBRA', Wageningen, The Netherlands	Scientific community (higher education, Research), Industry	100	EU
224	SP10/WP10.3	Oral presentation to a wider public	UCCS-CNRS	Eco-conception : une démarche responsable' course: 'Biomasse, Bioraffineries & Catalyse	09/04/2013	Ecole Centrale de Lille, 2nd year students, Villeneuve d'Acsq, France	Scientific community (higher education, Research)	100	France
225	SP10/WP1	Oral	UCCS-	Valorisation Catalytique de la	04/07/2013	Séminaire à la Société	Industry	10	France

	0.3	presentation to a wider public	CNRS	Biomasse		Industrielle des Oléagineux, 4 Juillet, Saint-Laurent-Blangy, France			
226	SP10/WP1 0.3	Oral presentation to a wider public	UCCS-CNRS	L'Innovation au Service du Développement Durable, Valorisation de la Biomasse	22/06/2013	Les Journées Portes Ouvertes des Sites d'Excellence de Lille Métropole, Villeneuve d'Acsq, France	Civil Society	50	France
227	SP10/WP1 0.3	Oral presentation to a scientific event	UCCS-CNRS	Biomass, Biorefineries & Catalysis (Invited Conference)	04/11/2013	Malaga University, Malaga, Spain	Scientific community (higher education, Research)	50	EU
228	SP10/WP1 0.3	Oral presentation to a wider public	UCCS-CNRS	Défis de la Catalyse au Sein des Bioraffineries Intégrées (Invited Conference)	27/11/2013	SFR Condorcet, Reims, France	Scientific community (higher education, Research), Industry	50	France
229		Poster	UCCS-CNRS	Ruthenium Catalysts for Olefin Metathesis of Renewable Feedstocks	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
230	VC 6	Oral presentation to a wider public	PDC	Integrated biorefineries in the European Landscape	12/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers,	250	International

							Medias		
231	VC 1	Oral presentation to a wider public	ARKEMA	Connecting Feedstock availability and Market opportunities. Case study on a Madagascar and a European Vegetable Oil Biorefinery	12/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
232		Poster	DTI	Biomass logistics - a complex tool for optimizing cost, energy consumption and CO2 emissions	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
233		Oral presentation to a wider public	CIRCC	Integration of biotechnology and catalysis for the valorization of waste streams	12/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
234		Oral presentation to a wider public	UCCS-CNRS	Introduction to EuroBioRef	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International

235		Oral presentation to a scientific event	UCCS-CNRS	Bioraffineries de Nouvelle Génération : une Intégration Multidisciplinaire	06/02/2014	Vers une Chimie doublement verte, Reims, France	Scientific Community (higher education, Research)		France
236		Poster	SINTEF	Formation of HMF and FFA from Hexoses and Pentoses	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
237		Poster	CERTH	Experimental and techno-economic evaluation of biomass thermochemical conversion to aviation fuels	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
238		Poster	TUHH	Bioconversion of biomass to valuable chemicals and bio-fuel	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
239		Poster	QUANTIS	Sustainability assessment as a tool for process optimization and value chain selection	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research),	250	International

							Industry, Civil Society, Policy makers, Medias		
240		Poster	IMPERIAL	Modelling economic uncertainties to inform prioritisation of biorefinery value chains	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
241		Poster	IMPERIAL	Policy, barriers and socio-economic impacts	11/02/2014	Tomorrow's biorefineries in Europe, Brussels, Belgium	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	250	International
242		Press releases	ALMA	Press kit - Results of the EurobioRef research programme	13/02/2014	48M meeting, Lille, France	Scientific Community (higher education, Research), Industry, Medias	50	EU
243	SP10/WP10.3	Oral presentation to a wider public	UCCS-CNRS	Chemistry of biomass: catalysis for producing key chemical intermediate	01/09/2013	Master 'CEE' (Chemistry Energy Environment) combined with last year students of the ENSCL engineers school, 20h of lecture, Lille, France	Scientific Community (higher education, Research)	100	France
244	SP10/WP10.3	Oral presentation	UCCS-CNRS	Impact des carburants Bilan environnemental des différentes	01/09/2013	Master 'CEE' (Chemistry Energy Environment).	Scientific Community	100	France

		to a wider public		filières énergétiques pour les applications mobiles, amélioration des carburants et biocarburants		16h of lecture, Lille, France	(higher education, Research)		
245	WP5.2	Oral presentation to a scientific event	UCCS-CNRS	Toward the understanding of methanol acetalization to di-methoxymethane over a FeMo based catalyst.	01/09/2013	11th European Congress on Catalysis – EuropaCat-XI, Lyon, France	Scientific community (higher education, Research)		International
246	SP5/WP5.5	Oral presentation to a scientific event	TUDO	Theoretical investigation of a semicontinuous distillation process for the separation of bio-based impurities	28/04/2013	AIChE 2013 Spring Meeting, San Antonio, Texas, US	Scientific Community (higher education, Research)		International
247		TV clip	UCCS-CNRS	La chronique de Miss Green	27/02/2014	Direct 8 Le Grand 8, French TV Channel	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	186000	France
248		TV clip	UCCS-CNRS	L'alternative au pétrole	27/02/2014	Grand Lille TV, French TV chanel	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	85000	France
249		Articles published in the popular press	UCCS-CNRS	Bioraffineries	01/02/2014	Agro Distribution, National French Newspaper	Scientific Community (higher education, Research),	10000	France

							Industry, Civil Society, Policy makers, Medias		
250		Articles published in the popular press	UCCS-CNRS	Agenda	04/02/2014	La Dépêche Le Petit Meunier, National French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	25000	France
251		Articles published in the popular press	UCCS-CNRS	La bioraffinerie du futur va révolutionner la chimie en Europe	13/02/2014	Les Echos, National French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	460000	France
252		Articles published in the popular press	UCCS-CNRS	Europe. Quand industriels et chercheurs s'intéressent à la biomasse	21/02/2014	La France Agricole, National French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	160000	France
253		Articles published in the popular press	UCCS-CNRS	EuroBioRef. Du carburant aviation à partir de lignocellulose	21/02/2014	La lettre de Circuits Culture, National French Newspaper	Scientific Community (higher education, Research), Industry, Civil	600	France

							Society, Policy makers, Medias		
254		Articles published in the popular press	UCCS-CNRS	Des plantes de plus en plus prisées pour du bioplastique	22/02/2014	Le Figaro, National French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	1305000	France
255		Articles published in the popular press	UCCS-CNRS	Biocarburants, les Etats-Unis ont un temps d'avance dans l'industrialisation de la 2G	24/02/2014	Bulletin de l'industrie pétrolière, National French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	4000	France
256		Articles published in the popular press	UCCS-CNRS	Chimie verte, la viabilité démontrée de la bioraffinerie flexible	28/02/2014	Green News Techno , National French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	10000	France
257		Articles published in the popular press	UCCS-CNRS	Avec EuroBioRef, le « pétrole vert » jaillit des labos nordistes	13/02/2014	La Voix du Nord, Local French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy	1300000	France

							makers, Medias		
258		Articles published in the popular press	UCCS-CNRS	Le « pétrole vert » jaillit des labos nordistes	13/02/2014	Nord Eclair, Local French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	120000	France
259		Articles published in the popular press	UCCS-CNRS	Chimie du végétal, ce n'est plus de la science-fiction	21/02/2014	Horizons Nord-Pas de Calais, Local French Newspaper	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	50000	France
260		Websites/Applications	UCCS-CNRS	Présentation des résultats du programme de recherche EuroBioRef	17/01/2014	Mediaterre, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	200	France
261		Websites/Applications	UCCS-CNRS	Agriculture et chimie : le mariage d'avenir !	12/02/2014	Le Huffington Post, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers,	2000000	France

							Medias		
262		Websites/Applications	UCCS-CNRS	Avec EuroBioRef, le « pétrole vert » jaillit des labos nordistes	12/02/2014	La Voix du Nord, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	200000	France
263		Websites/Applications	UCCS-CNRS	La bioraffinerie du futur va révolutionner la chimie en Europe	13/02/2014	Les Echos, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	2000000	France
264		Websites/Applications	UCCS-CNRS	Revue du web : environnement	14/02/2014	France Culture, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	500000	France
265		Websites/Applications	UCCS-CNRS	EuroBioRef : des résultats prometteurs	14/02/2014	Construction Cayola, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	10000	France

266		Websites/Applications	UCCS-CNRS	EuroBioRef dévoile le fruit de ses recherches sur les alternatives végétales au pétrole	14/02/2014	L'énergie en questions, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		France
267		Websites/Applications	UCCS-CNRS	EuroBioRef : un projet de recherche européen au coeur des enjeux de l'économie durable	14/02/2014	Université Lille 1, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		France
268		Websites/Applications	UCCS-CNRS	EU Biorefinery project shows biorefineries could generate 200,000 jobs by 2020	17/02/2014	BioFuelsDigest, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	10000	US
269		Websites/Applications	OBRPR	EuroBioRef research programme results	17/02/2014	OBR JSC, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		Poland
270		Websites/Ap	UCCS-	Quand industriels et chercheurs	18/02/2014	La France Agricole,	Scientific	10000	France

		plications	CNRS	s'intéressent à la biomasse		Website article	Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		
271		Websites/Applications	UCCS-CNRS	Débouchés non alimentaires : Quand industriels et chercheurs s'intéressent à la biomasse	19/02/2014	Newsletter La France Agricole, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	50000	France
272		Websites/Applications	UCCS-CNRS	Des plantes de plus en plus prisées pour du bioplastique	22/02/2014	Le Figaro, Website article	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	50000	France
273	SP10 / WP10.2 / D10.2.4	Oral presentation to a wider public	UCCS-CNRS	Standard_Set of Slides for Eurobioref Consortium Version 3	21/06/2016	http://www.eurobioref.org/	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		International
274	SP10 / WP10.2 /	Oral presentation	UCCS-CNRS	Standard_Set of Slides for Eurobioref Consortium Version 4	03/03/2014	http://www.eurobioref.org/	Scientific Community		International

	D10.2.4	to a wider public					(higher education, Research), Industry, Civil Society, Policy makers, Medias		
275		Oral presentation to a scientific event	CRES	Novel non-food crops for modern biorefineries	03/06/2013	21st EU BC&E, Copenhagen, Denmark	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	100	EU & US
276		Oral presentation to a wider public	CRES	Oil crops for biofuels and green chemicals	06/06/2013	21st EU BC&E, Copenhagen, Denmark, Eurobioref Workshop	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias	50	EU, US, Canada, NZ
277	WP5.2.4	Oral presentation to a scientific event	FEUP	Pervaporation Membrane Reactor for DBE synthesis	07/07/2013	11th International Conference on Catalysis in Membrane Reactors, Porto, Portugal	Scientific community (higher education, Research)		International
278		Poster	CRES	Yield and biomass quality of selected lignocellulosic crops produced for an integrated multi-product biorefinery	08/09/2013	The 4th International Environmental Best Practices Conference, Olsztyn, Poland	Scientific community (higher education, Research), Industry		International
279		Oral	UWM	Short rotation coppice for energy	06/06/2013	21st EU BC&E,	Scientific	50	EU, US,

		presentation to a scientific event		and biorefinery		Copenhagen, Denmark, Eurobioref Workshop	Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		Canada, NZ
280	SP10	Organisation of a workshop	CIRCC	EuroBioRef Summer School	18/09/2011	Castro-Apulia, Italy	Scientific community (higher education, Research), Industry	50	EU
281	SP10	Organisation of a workshop	TUDO	Reactive Molecular Separations	18/04/2012	Technical University of Dortmund, Germany	Scientific community (higher education, Research), Industry	5	EU
282	SP10	Organisation of a workshop	UWM	Biomass cultivation for the production of chemicals and fuels	10/12/2012	University of Warmia and Mazury in Olsztyn, Poland	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers	50	EU
283	SP10	Organisation of a workshop	CRES	Energy and feed crops in Thrace	10/01/2014	Komotini, Prefecture of Thrace, Greece	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers	40	EU
284	SP10	Organisation	CERTH	Biomass gasification	28/01/2014	CERTH, Thessaloniki,	Scientific	13	EU

		of a workshop				Greece	community (higher education, Research)		
285	SP10	Organisation of a workshop	PDC	Life-Cycle Assessment of Biorefineries	12/12/2013	PDC, Breda, The Netherlands	Scientific community (higher education, Research), Industry	12	EU
286	SP10	Video	ALMA	Results of the EuroBioRef project	28/02/2014	http://www.eurobioref.org/	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		International
287		Oral presentation to a wider public	ARKEMA	High added value chemicals from non-edible biomass oil: low temperature catalysis	19/11/2013	Ecochem, International Conference & Exhibition on Sustainable Chemistry & Engineering. Basel, Switzerland	Scientific Community (higher education, Research), Industry		EU
288	WP5.1	Poster	UCCS-CNRS	Heterogeneous Ruthenium Catalysts for cross Metathesis involving Renewable Feedstocks	14/07/2013	International Symposium on Olefin Metathesis (ISOM20) Nara, Japan	Scientific community (higher education, Research), Industry		International
289		Poster	CERTH	Circulating fluidized bed gasification of 1st and 2nd generation biofuelseed cakes after oil extraction.	03/06/2013	21st EU BC&E, Copenhagen, Denmark	Scientific Community (higher education, Research), Industry, Civil		EU & US

							Society, Policy makers, Medias		
290		Poster	CERTH	Comparing calcined and fresh olivineas bed materials for tar reduction in Fluidized Bed gasification	03/06/2013	21st EU BC&E, Copenhagen, Denmark	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		EU & US
291		Poster	CERTH	Plant design aspects of catalytic biosyngas conversion to h.a	01/06/2012	20th EU BC&E, Milan, Italy	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias		EU & US

* A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, other.
** A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias ('multiple choices' is possible.