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D10.12 Highlights of CASCATBEL's annual progress for public dissemination

30/10/2017

Project Acronym	CASCATBEL
Project Title	CAScade deoxygenation process using tailored nanoCATalysts for the production of BiofuELs from lignocellullosic biomass
Project Reference	604307
Call identifier	FP7-NMP-2013-LARGE-7
Theme	Nmp.2013.1.1-1: Exploration, optimization and control of nano-catalytic processes for energy applications
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	Nr.	Name
Deliverable	10.12	Highlights of CASCATBEL's annual progress for public dissemination.
Work Package	10	Dissemination and exploitation.
Task	10.1	Dissemination and cooperation with other initiatives.

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Version	Date	Author/Reviewer	Description
1.0	27/10/2017	E. Mateos/ D. Serrano	Final

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1. SUMMARY

The present report contains highlights of CASCATBEL project progress in its fourth and last year of activity for public dissemination, in particular in relation to project objectives, work progress and achievements, project management, dissemination and communication activities.

2. PROJECT OBJECTIVES, WORK PROGRESS AND ACHIEVEMENTS

2.1 Project description

CASCATBEL aims to design, optimize and scale-up a novel multi-step process for the production of second-generation liquid biofuels from lignocellulosic biomass in a cost-efficient way through the use of next-generation high surface area tailored nano-catalysts. On the one hand, the sequential coupling of catalytic steps is an essential factor for achieving a progressive and controlled biomass deoxygenation and reduce hydrogen consumption, avoiding the problems that hinder one/two-step bio-oil upgrading processes. On the other hand, the use of tailored nano-catalysts allows optimising reaction yields (increasing liquid yield and preventing bio-oil contamination) and facing limitations of current catalysts in terms of selectivity and deactivation rates. Finally, the scaling up of the process is important for fully exploring and understanding the catalytic and reaction dynamics, assessing catalyst life-cycles and demonstrating the viability of the CASCATBEL process in relevant environments, from both technical and economic perspectives.

The strategy proposed in CASCATBEL is leading to the preparation of advanced biofuels having composition and properties very similar to petroleum-derived fuels. This is a very relevant advantage regarding the commercial implementation of this technology, as it would not require any significant changes in the already existing infrastructures and engines.

CASCATBEL activities are structured in eleven work packages (WP) which are tightly linked to each other as shown in the figure below:

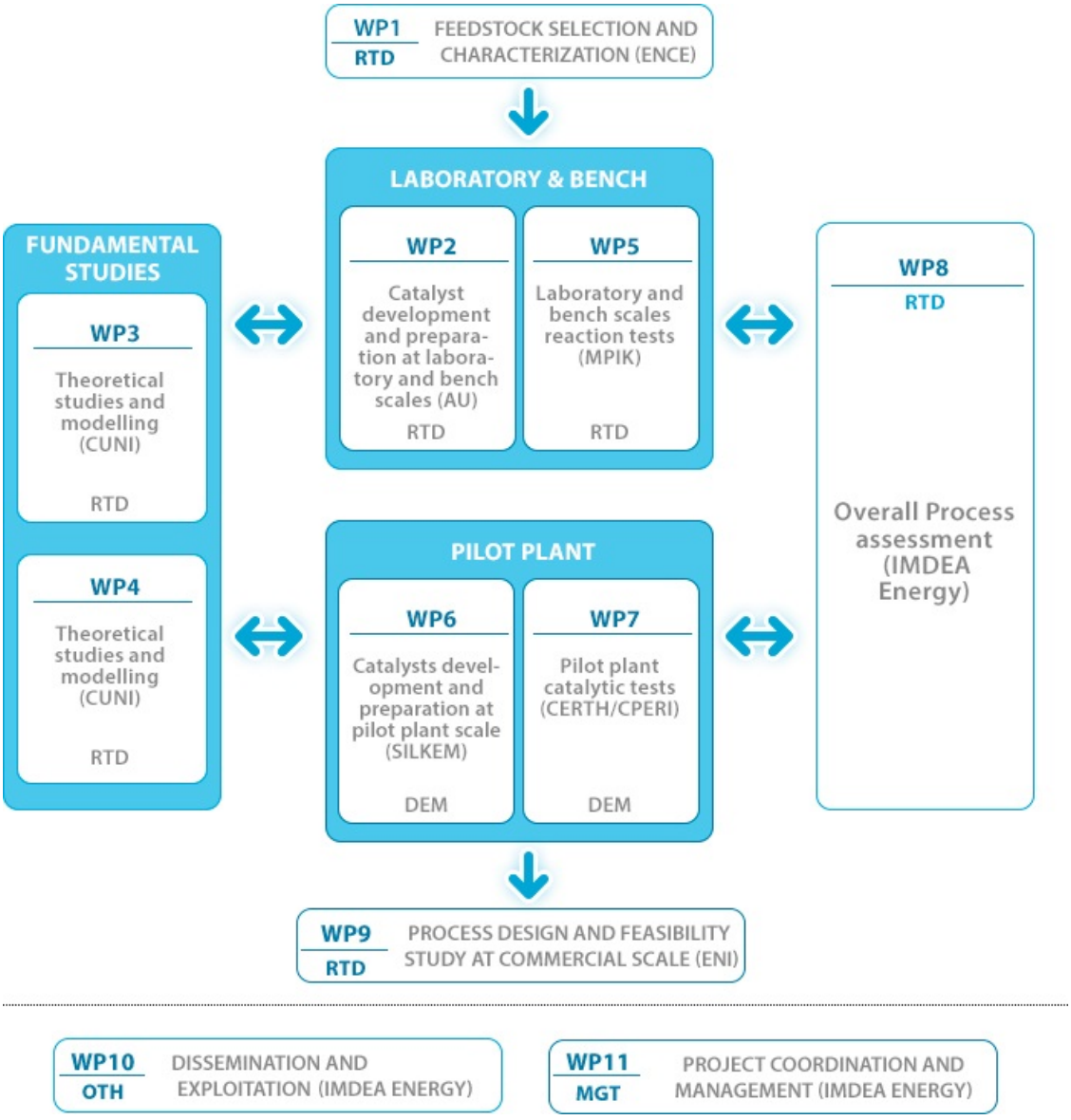

Figure 1 Work programme structure of CASCATBEL project

2.2 Project objectives in the fourth year of project

During the fourth year of execution, CASCATBEL aimed at the following objectives:

Table 1 Objectives of the CASCATBEL project during the 4th year

OBJECTIVE	DESCRIPTION
01	Modelling of the reactant/products adsorption and interaction with the active sites; modelling of the catalyst deactivation phenomena and modelling of the reaction kinetics and catalyst deactivation rates.
02	Application of advanced characterization and in-situ techniques to gain a profound insight into the different phenomena taking place during the catalytic reactions and about the nature and environment of the active sites.

03	Optimization of the thermal pyrolysis of selected biomass samples in order to optimize both the bio-oil production and energy yield.
04	Preparation at pilot plant scale of selected catalyst for: a) catalytic pyrolysis, b) intermediate bio-oil deoxygenation and c) bio-oil hydrodeoxygenation.
05	Pilot plant scale tests of: a) biomass catalytic pyrolysis; b) intermediate bio-oil deoxygenation and c) bio-oil hydrodeoxygenation.
06	To perform process assessment as a transversal activity to aid in the decisions to be taken regarding the different milestones to be achieved in this period. The assessment is carried out taking into consideration a variety of criteria: technical, economic, environmental, safety and toxicological criteria.
07	Evaluation of process feasibility at commercial scale.
08	Dissemination of the project results to scientific and general public as well as to foster relations with stakeholders.
09	To lay the foundations for project results exploitation by facilitating its protection, analysis and transfer.

Along the reporting period the following milestones were achieved:

Table 2 Milestones of the CASCATBEL project during the 4th year

MILESTONE	NAME	ACHIEVEMENTS
MS9	Optimized catalytic pyrolysis	Optimum catalyst and operation conditions for biomass catalytic pyrolysis selected and specified
MS10	Optimized intermediate bio-oil deoxygenation	Optimum catalyst and operation conditions for intermediate bio-oil deoxygenation selected and specified
MS11	Optimized hydrodeoxygenation	Optimum catalyst and operation conditions for intermediate deoxygenation selected and specified
MS12	Commercial feasibility study	Process feasibility at commercial scale established and next steps for exploitation and commercialization agreed

2.3 Work progress and achievements

Eight out of the eleven WPs have been active along the fourth year of the project. The progress and achievements of each of those WPs is summarized as follows:

WP3- Theoretical studies and modelling

The main objectives in WP3 in third period were to perform theoretical studies and modeling for a better understanding of deactivation phenomena in the catalytic systems selected and to determine the reaction kinetics of the different chemical steps in the cascade process and catalyst deactivation rates based on the results of pilot plant scale experiments and long-term reactions. This analysis is essential for further scale-up of the process for commercial purposes.

WP4- Advanced characterization and in-situ monitoring

The objective in WP4 during this period was the application of advanced characterization and in-situ techniques to gain a more profound insight into the deactivation phenomena taking place during the catalytic biomass conversion reactions of the cascade process at pilot plant scale. It included the elucidation of deactivation pathways and the identification of the species causing catalyst deactivation.

WP6-Catalysts development and preparation at pilot plant scale

The major objective of WP6 was to prepare and characterize the selected catalysts in the quantity required to be used in the pilot plant scale experiments.

WP7-Pilot plant catalytic tests

WP7 involved the performance tests of the catalysts prepared in WP6 at pilot plant scale. Three main chemical transformations were being investigated in pilot plant scale: catalytic pyrolysis, intermediate deoxygenation and hydrodeoxygenation.

WP8- Overall process assessment

Main objective of WP8 during this period was the assessment of results obtained for the three catalytic steps of the cascade process (biomass catalytic pyrolysis, bio-oil intermediate deoxygenation and bio-oil HDO) at pilot plant scale, to aid in the selection of the optimum catalyst and reaction conditions. The assessment considered different criteria including technical, cost, environmental, nanosafety and toxicological criteria. Assessment results served to assist in the achievement of milestones MS10, MS11 and MS12.

WP9-Process design and feasibility study at commercial scale

Based on the results of the pilot plant experiments in WP7 and the overall process assessment in WP8, WP9 aimed to elaborate the conceptual design of the integrated process and

determine its viability at commercial scale. Process was optimized considering different plant capacities and types of lignocellulosic biomass, and minimizing the external energy needs and generation of waste streams.

WP10- Dissemination and exploitation

Dissemination and communication activities were performed in order to disseminate project results and main achievements. The potential of project results was continuously analysed by the Innovation Committee in order to define a proper exploitation strategy.

Main dissemination and communication activities are detailed in Section 3.

WP11- Financial and administrative management

CASCATBEL Grant Agreement and Consortium Agreement are the contractual documents which guided the management procedures of project Coordinator towards the consortium and the EC. Main activities of project management during this period were the following:

- To control and archive effectively documentation generated within the project.
- To ensure efficient communication mechanisms within the consortium partners.
- To deliver consolidated reports timely and with appropriate technical quality.
- To continuous handling of the project correspondence, attend external stakeholders interested in project activities and assist project partners in the day-to-day financial and administrative doubts and requests.
- To synchronize the efforts in the WPs with the project time schedule, monitor overall project progress and ensure a proper level of cooperation within the consortium.
- To distribute EC financial contribution within the consortium according to internal agreements and with undue delay.
- To keep fluent communication with the EC.

During this period the following meetings took place:

Table 3 CASCATBEL project meetings during the 4th year

PROJECT MEETINGS	DATE	VENUE
Governing Board Meeting	13th-14th February 2017	Utrecht (The Netherlands)
WP9 Technical Meeting	23th March 2017	Frankfurt (Germany)
Governing Board Meeting	25th-26th April 2017	Birmingham (United Kingdom)
WP9 Technical Meeting	18th May 2017	Frankfurt (Germany)
WP9 Technical Meeting and Governing Board Meeting	28th June 2017	Mülheim an der Ruhr (Germany)
WP9 Technical Meeting	6th September 2017	Frankfurt (Germany)
WP9 Technical Meeting	10th October 2017	Frankfurt (Germany)
Technical Committee, Innovation Committee and Governing Board Meeting	24th October 2017	Madrid (Spain)
Final project Meeting	25th October 2017	Madrid (Spain)

2.4 Deliverables

During this fourth year of project implementation, a total of 24 deliverables, which are shown in the following table, have been come out from CASCATBEL activities.

Table 4. Deliverables submitted during the fourth year of the project

DELIVERABLE	TITLE	DELIVERY DATE
D3.3	Report on the critical factors, based on theoretical studies, causing catalyst deactivation in pilot plant experiments	31/01/2017
D4.3	Report on the mechanism and effects of coke formation under working conditions over the catalysts investigated at pilot plant scale	31/01/2017
D7.1	Report on the biomass catalytic pyrolysis tests at pilot scale	31/01/2017
D7.2	Bio-oil samples from pilot plant biomass catalytic pyrolysis	31/01/2017
D8.7	Assessment of the results obtained at pilot plant to aid in the selection of the optimum catalyst and reaction conditions for biomass catalytic pyrolysis	28/02/2017
D7.3	Report on the catalytic tests of bio-oil intermediate deoxygenation at pilot plant scale	30/04/2017
D7.4	Bio-oil samples from pilot plant intermediate deoxygenation	30/04/2017
D8.8	Assessment of the results obtained at pilot plant to aid in the selection of the optimum catalyst and reaction conditions for the selected intermediate deoxygenation	30/04/2017
D3.5	Extension of D3.3 Report on the critical factors, based on theoretical studies, causing catalyst deactivation in pilot plant experiments	30/06/2017
D4.4	Extension of D4.3 Report on the mechanism and effects of coke formation under working conditions over the catalysts investigated at pilot plant scale	30/06/2017
D6.2	Catalyst samples for pilot plant scale experiments	30/06/2017

D6.3	Basic characterization data of the catalyst samples prepared at pilot plant scale	30/06/2017
D7.6	Advanced biofuels and char samples	30/06/2017
D7.7	Report on the properties of the advanced bio-fuels and char samples	30/06/2017
D10.10	Stakeholders Event	30/06/2017
D3.4	Reaction kinetics and catalyst deactivation rates of the reactions and catalysts investigated at pilot plant scale	31/07/2017
D7.5	Report on the bio-oil HDO tests at pilot plant scale	31/07/2017
D8.9	Assessment of the results obtained at pilot plant to aid in the selection of the optimum catalyst and reaction conditions for bio-oil HDO	30/06/2017
D9.1	Process flow diagram including upstream and downstream steps	31/07/2017
D9.2	Optimized process from simulation tools	30/09/2017
D9.3	Report on the commercial feasibility of the process	31/10/2017
D10.11	Updated results exploitation strategy	31/10/2017
D10.12	Highlights of CASCATBEL´s annual progress for public dissemination	31/10/2017
D10.13	Final version of the Dissemination plan	31/10/2017

3. DISSEMINATION AND COMMUNICATION ACTIVITIES

3.1 Scientific publications of project results in peer-review journals

During the fourth year, a total of 16 publications in peer-review journals have been accepted (published or in press), including 11 publications in high-impact journals and 5 publications in journals without impact factor, related to the project research topics (renewable energy, biomass, biofuels, nanomaterials, catalysis).

The complete list of publications in indexed journals is detailed below:

- Cao, Z.; Engelhardt, J.; Dierks M.; Clough, M. T.; Wang, G.-H.; Heracleous, E.; Lappas, A.; Rinaldi, R*.; Schüth, F*. ***Catalysis meets nonthermal separation for the production of (alkyl) phenols and hydrocarbons from pyrolysis oil***. *Angew. Chem. Int. Ed.,* ***2017****, 56 (9),* 2334–2339.

- Engelhardt, J.; Lyu, P.; Nachtigall, P.; Schüth, F.; García, Á. M*. ***The Influence of water on the performance of molybdenum carbide catalysts in hydrodeoxygenation reations: A combined theoretical and experimental study***. *ChemCatChem,* ***2017****, 9 (11),* 1985–1991.

- Fermoso J.; Pizarro, P.; Coronado, J. M.; Serrano, D. P*. ***Advanced biofuels production by upgrading of pyrolysis bio-oil***. WIREs Energy Environ.*,* ***2017****, 6 (4),* e245.

- Tosoni, S*.; Pacchioni, G. ***Influence of surface hydroxylation on the Ru atom diffusion on the ZrO_2(101) surface: A DFT study***. Surface Science, **2017**, *664*, 87-94.

- Ruiz-Puigdollers, A.; Illas, F.; Pacchioni, G*. ***Reduction of hydrogenated ZrO_2 nanoparticles by water desorption***. ACS Omega, **2017**, *2 (7)*, 3878-3885.

- Ruiz Puigdollers, A.; Schlexer, P.; Tosoni, S.; Pacchioni, G*. ***Increasing oxide reducibility: the role of metal/oxide interfaces in the formation of oxygen vacancies.*** ACS Catalysis, **2017**, *7 (10)*, 6493-6513.

- Manayil, J. C*.; Osatiashtiani, A*.; Mendoza, A.; Parlett, C. M. A.; Isaacs, M. A.; Durndell, L. J.; Michailof, C.; Heracleous, E.; Lappas, A. A. ; Lee, A. F.; Wilson, K*. ***Impact of macroporosity on catalytic upgrading of fast pyrolysis bio-oil by esterification over silica sulfonic acids.*** ChemSusChem, **2017**, *10 (17)*, 3506-3511.

- Fermoso, J.; Hernando, H.; Jiménez-Sánchez, S.; Lappas, A. A.; Heracleous, E.; Pizarro, P.; Coronado, J. M.; Serrano, D. P*. ***Bio-oil production by lignocellulose fast-pyrolysis: Isolating and comparing the effects of indigenous versus external catalysts***. Fuel Processing Technology, **2017**, 167, 563-574.

- Hernández-Giménez, A. M.; Ruiz-Martínez, J.; Puértolas, B.; Pérez-Ramírez, J.; Bruijnincx, P. C. A.; Weckhuysen, B. M*. ***Operando Spectroscopy of the Gas-Phase Aldol Condensation of***

Propanal over Solid Base Catalysts. Top. Catal., **2017**, (in press). DOI: 10.1007/s11244-017-0836-7

- Hernando, H.; Fermoso, J.; Ochoa-Hernández, C.; Opanasenko, M.; Pizarro, P.; Coronado, J. M.; Čejka, J.; Serrano, D. P*. ***Performance of MCM-22 zeolite for the catalytic fast-pyrolysis of acid-washed wheat straw***. Catal. Today, **2017**, (in press). DOI: 10.1016/j.cattod.2017.09.043

- Tosoni S.; Chen, H.Y.T.; Ruiz Puigdollers, A.; Pacchioni G*. ***TiO_2 and ZrO_2 in biomass conversion: why catalyst reduction helps***. Phil. Trans. R. Soc., **2017**, (in press). DOI: 10.1098/rsta.2017.0056

In addition, a **special issue** in the journal "Biomass Conversion and Biorefinery" was published, with a collection of selected papers originally presented at the "Thermochemical lignocellulose conversion technologies workshop" that was organized in Greece in May 2016 by CERTH/CPERI and TUHH in the frame of CASCATBEL project:

- ***Advances in catalytic biomass fast pyrolysis and bio-oil upgrading***. Biomass Conversion and Biorefinery, 2017, Volume 7, Issue 3. Issue Editors: Heracleous, E.; Lappas, A. A.; Serrano, D. P.

Five CASCATBEL works were published in this special issue:

- Hernando, H.; Fermoso, J.; Moreno, I.; Coronado, J. M.; Serrano, D. P.; Pizarro, P*. ***Thermochemical valorization of camelina straw waste via fast pyrolysis***. Biomass Conv. Bioref., **2017**, *7 (3)*, 277–287.

- Hernando, H.; Moreno, I.; Fermoso, J.; Ochoa-Hernandez, C.; Pizarro, P.; Coronado, J. M.; Čejka, J*.; Serrano, D. P*. ***Biomass catalytic fast pyrolysis over hierarchical ZSM-5 and Beta zeolites modified with Mg and Zn oxides***. Biomass Conv. Bioref., **2017**, *7 (3)*, 289–304.

- Heracleous, E*.; Gu, D.; Schüth, F.; Bennett, J. A.; Isaacs, M. A.; Lee, A. F.; Wilson, K.; Lappas, A. A. ***Bio-oil upgrading via vapor-phase ketonization over nanostructured FeOx and MnOx: catalytic performance and mechanistic insight***. Biomass Conv. Bioref., **2017**, *7 (3)*, 319–329.

- Osatiashtiani, A.; Puertolas, B.; Oliveira, C.C.S.; Manayil, J. C.; Barbero, B.; Isaacs, M.; Michailof, C.; Heracleous, E.; Pérez-Ramírez, J.; Lee, A. F.; Wilson, K*. ***On the influence of Si:Al ratio and hierarchical porosity of FAU zeolites in solid acid catalysed esterification pretreatment of bio-oil***. Biomass Conv. Bioref., **2017**, *7 (3)*, 331–342.

- Morales-García, A*.; He, J.; Lyu, P.; Nachtigall, P. ***Exploring the stability and reactivity of Ni_2P and Mo_2C catalysts using ab initio atomistic thermodynamics and conceptual DFT approaches***. Biomass Conv. Bioref., **2017**, *7 (3)*, 377–383.

3.2 Publications in specialized books

The following chapters in books were published during the period:

- Serrano, D. P.; Melero, J. A.; Coronado, J. M.; Pizarro P.; Morales, G. ***Chapter 12: Biomass Conversion over Zeolite Catalysts***. ISBN: 978-1-78262-784-5. *Zeolites in Catalysis: Properties and Applications*. Editors: Čejka, J.; Morris, R.E.; Nachtigall, P. RSC Publishing (2017)

- Osatiashtiani, A.; Lee, A.F.; Wilson K. ***Tailored porous Catalysts for Esterification Processes in Biofuels production***. Print-ISBN: 9783527339143. *Nanotechnology in Catalysis: Applications in the Chemical Industry, Energy Development, and Environment Protection*. Editors: Van de Voorde, M.; Sels, B. Wiley-VCH Verlag GmbH & Co KGaA (2017)

- Thormann, L., Pizarro de Oro, P. ***Fuels from Pyrolysis***. ISBN: 978-3-662-53063-4. *Biokerosene - Status and Prospects*. Editors: Kaltschmitt, M., Neuling, U. Springer-Verlag Berlin Heidelberg (2018)

3.3 Participation in national and international congresses, conferences and other scientific meetings and events

Project partners have participated in a variety of national and international congresses, conferences and other scientific meetings and events related to renewable energy, biomass and catalysis, presenting the project and/or its results. During fourth year, CASCATBEL project has been present in 20 scientific events, as summarized below:

- 48th Symposium on Catalysis, Prague (Czech Republic), 7-9th November 2016, plenary lecture, oral communications and poster presentation.

- MIT Club of Germany, Hamburg (Germany), 11th November 2016, lecture.

- 4th TYC-Energy Materials Workshop-Shaping nanocatalysis, King's College London, London (United Kingdom), 16th December 2016, lecture.

- JungChemikerForum, Albert-Ludwigs-Universität, Freiburg (Germany), 30th January 2017, lecture.

- Angewandte Symposium "Chemistry for Our Future", Tel-Aviv (Israel), 15th February 2017, lecture.

- Weizmann Institute of Science, Tel-Aviv (Israel), 16th February 2017, lecture.

- Netherlands Chemistry and Catalysis Conference, Noordwijkerhout (Netherlands), 6-8th March 2017, oral communication.

- Institut des Nanosciences de Paris, CNRS, Paris (France), 28th April 2017, lecture.

- Discussion Meeting "Providing sustainable catalytic solutions for a rapidly changing world", Royal Society, London (UK), 8th May 2017, lecture.

- 2nd Green and Sustainable Chemistry GCSII, Berlin (Germany), 15th May 2017, lecture.

- 11th Panhellenic Chemical Engineering Conference, Thessaloniki (Greece), 25-27th May 2017, oral communications.

- 7th Czech-Italian-Spanish Symposium on Catalysis, Trest (Czech Republic), 13-17th June 2017, plenary lectures, oral communications and poster presentation.

- CeNTech Day 2017, 14th June 2017, Münster (Germany), lecture.

- Spanish Society of Catalysis (SECAT) Conference 2017, Oviedo (Spain), 26-28th June 2017, oral communication.

- 13th European Congress on Catalysis (EUROPACAT), Florence (Italy), 27-31th August 2017, plenary lecture, oral communications and poster presentation.

- Workshop on Layered Materials, Trest (Czech Republic), 1-5th September 2017, oral communication and poster presentation.

- Tcbiomass2017 - The international conference on thermochemical biomass conversion science, Chicago (USA), 19-21st September 2017, oral communication.

- GEZ school on Zeolites - New trends & future challenges, Móstoles (Spain), 27-29th September 2017, lectures, poster and short oral communication.

- 10th World Congress of Chemical Engineering (WCCE 2017), Barcelona (Spain), 1-5th October 2017, oral communications and poster presentations.

- Ruhr Symposium, Duisburg (Germany), 12th October 2017, lecture.

3.4 Networking activities

With the aim of promoting synergies with different groups working on thematic areas related to CASCATBEL, the project has participated in the following clusters and events:

- Nanosafety cluster. The goal of this cluster is to maximise the synergies between the existing FP6 and FP7 projects addressing all aspects of nanosafety including toxicology, ecotoxicology, exposure assessment, mechanisms of interaction, risk assessment and standardisation.
- European cluster on catalysis. The main aim of this initiative is to better integrate fragmented activities in Europe, create synergies between European projects and provide input on potential future catalysis-related research to the European Commission.

Cooperation in the preparation of the "Science and Technology Roadmap on catalysis for Europe: A path to create sustainable future" has been produced.

- Engineering and upscaling cluster. This cluster intends to: identify common interests (scientific, technical and commercial) in on-going research and innovation activities; support policy-making; identify methods to support and strengthen dissemination activities of the projects of the cluster; help projects to support their individual and common innovation and exploitation activities.
- Industrial Innovation Liaison (i2L). This initiative is a cross-linking working group between the NanoSafety Cluster and the European Pilot Production Network, which brings together all nano-safety relevant experts from pilot-line and production projects. It aims at facilitating the transfer of state-of-the art nanosafety knowledge and of safe-by-design strategies to product development.
- 10th World Congress of Chemical Engineering (WCCE 2017), Barcelona (Spain), 1th-5th October 2017. An International Symposium on Lignocellulosic Materials was organized in the WCCE 2017 with the joint participation of projects FASTCARD, BIOGO and CASCATBEL.

3.5 Newsletters

A project newsletter was elaborated aimed to inform partners, public authorities and policy makers, researchers, industries and stakeholders in general, about project achievements, milestones, events and publications.

Two issues of CASCATBEL's electronic newsletter were published in the project website and distributed by email to more than 300 stakeholders:

- Issue 10-April 2017
- Issue 11-August 2017

3.6 General public communications and science dissemination events

CASCATBEL project has been presented in various events to the general public:

- Spanish National Conference on Environment (CONAMA), Madrid (Spain), 30th November 2016, oral communication.
- 5th Annual Workshop of young researchers, IMDEA Energy, Móstoles, Madrid (Spain), 16th December 2016, oral communication and poster presentation.

In addition, outreach activities in science dissemination events during this period were:

- The Science Week, Madrid (Spain), organized at IMDEA Energy, 7-10th November 2016. Focused to students in secondary school. Workshop of biofuels production at laboratory scale and visit to the pilot plant of pyrolysis and HDO.

- 8th European Researchers' Night in Madrid 2017, The Energy Universe, Madrid (Spain), organized at IMDEA Energy, 29th September 2017. Focused to young children. Benefits of renewable energies and biofuels for environment and climate change were explained through workshops. The CASCATBEL leaflet was included in the European corner, which was designed for adult attendees, as an information point of the European funded activities in the Institute.

3.7 CASCATBEL Stakeholders Event

The purpose of CASCATBEL Stakeholders Event was to join experts from industries and other stakeholders of the nanotechnology, catalysts and biofuels fields in order to present and discuss main achievements of the CASCATBEL project, so relevant feedbacks could be received regarding the potential of project results, to be commercially exploited.

It was organized by the Max-Planck-Institut für Kohlenforschung (MPIK) with the active collaboration of ENI and IMDEA Energy. The event was hosted by MPIK and it was held on 29th June 2017 in Mülheim an der Ruhr (Germany).

Nine external experts in the field of catalysts and biofuels production joined the event, included representatives from UPM Biorefining, BTG-BTL, Evonik Industries, IFP Energies Nouvelles, Johnson Matthey, BASF, Neste, EERA Bioenergy (SP1 Thermo-Chemical Platform) and the Cluster of Excellence on Tailor-Made fuels from biomass (TMFB) at RWTH Aachen University.

Consortium partners presented the actual scenario in advanced biofuels, the project and its objectives, main results in the three different steps in the cascade process and the potential industrial impact of the project. Presentations were followed with the feedback from the external participants and a final discussion on strategies for exploitation of project results and its potential impact.

The Stakeholders Event is considered to be a great success. All the external participants acknowledged the great quality and breadth of the research performed within the framework of CASCATBEL project and they expressed high interest in the current and future results of the project. Industrial experts highlighted some critical aspects of the project such as the relevance of deactivation and regeneration of catalysts, and the need to implement the utilization of the side streams of products for improving the economic and suitability of the whole value chain. The requirement of a techno-economic analysis was highlighted, which has actually been performed in the frame of the project in WP9.

4. CONCLUSIONS

During the fourth year of duration, CASCATBEL has achieved the planned objectives according to the designed time frame and no significant deviation has been produced. The mechanisms established for management, communication and quality control have proved to be effective.

Regarding the research activities in this period, pilot plant testing of the most promising catalytic systems selected at bench scale was performed and results obtained at pilot plant scale were assessed according to technical, economic, environmental and safety criteria. The experimental tasks performed in this period were carried out using real biomass and bio-oil samples and addressing issues related to the catalyst agglomeration and shaping in technical forms, the effect of transport phenomena and the extension of catalyst deactivation. In addition, the conceptual design of the integrated process and the study of its feasibility at commercial scale were performed in the period.

An intense dissemination activity of the project and the results so far achieved was performed, which is reflected in the 11 scientific publications in indexed journals, a special issue with works presented in the CASCATBEL workshop, 3 articles in books and the participation in 20 scientific events to present the project and its results.

In general, sound planning and high quality and proactive consortium members have been the keys for a successful implementation of the project.