



1st stakeholder engagement events and results' evaluation report

Unravel -Project

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Summary

This deliverable report describes the engagement and exploitation activities towards the diverse groups of UNRAVEL stakeholders carried out within the framework of the project in the period M1-M33, and describes the initial results that emerged from the activities. The work has been performed within WP7 and is linked to the progress achieved in the technical work packages (WP2, WP3, WP4, WP5 and WP6).

To achieve maximum impact of UNRAVEL, the target groups and potential users of project results have to be fully known and their needs have to be understood. The effective knowledge exchange and transfer of results and progress towards defined stakeholder groups is a crucial task to assure the uptake of project outputs by the wider research and knowledge community. The stakeholder engagement activities carried out within the UNRAVEL project are designed to maximize the project's impact and to facilitate the uptake of results and newly generated knowledge by all stakeholder groups. The details on the engagement activities are fully explained in the report.

Based on the stakeholder engagement activities performed so far and based in the evaluation of preliminary results and knowledge outputs as well as existing knowledge gaps and potential risks and future market barriers that are of relevance, we have come to the conclusion that the topic of securing a solid biomass supply chain and sound feedstock logistics is one of the most important areas for intense stakeholder engagement. The ground for more intense engagement with wider stakeholder groups has been paved with a comprehensive set of events planned for the coming stages of the project, as more innovative knowledge and results with relevance for policy makers, industrial stakeholders and citizens will become available. Another pressing topic for stakeholder action, especially with the private sector, is to identify the most promising applications for UNRAVEL lignin and related market prospects and risks that future market actors should be aware of.

The importance of both above-listed topics to support a strong bio-based economy and the necessity to engage with relevant stakeholders has lately been confirmed by the BBI JU in their Annual Work Plan (AWP) 2021. In line with the Strategic Innovation and Research Agenda (SIRA), the AWP 2021 confirms the commitment to strengthen the participation of biomass feedstock suppliers in the value chain. BBI JU further will encourage partnerships with end-market actors to create a market pull for bio-based products. In UNRAVEL, based on our stakeholder engagement strategy and hands-on action, we strongly contribute to these strategic goals as set out by BBI JU.



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1. Introduction

Aim of this document is to report on the engagement and exploitation activities towards the diverse groups of UNRAVEL stakeholders carried out within the framework of the project in the period M1-M33, and to describe initial results that emerged from the activities.

2. Progress towards objectives

To achieve maximum impact of a project the target groups and potential users of project results have to be fully known and their needs have to be understood. The effective knowledge exchange and transfer of results and progress towards defined stakeholder groups is a crucial task to assure the uptake of project outputs by the wider research and knowledge community. This will assure the sustainability of results and maximise the project's impact.

The specific objectives of UNRAVEL' stakeholder engagement activities are to:

- Enhance the project visibility at the local, national and international level
- Show how outcomes are relevant to public, e.g. by creating jobs, positive environmental impacts, that way maximizing support and acceptance and minimizing risks towards project outputs
- Work towards the European knowledge base on lignocellulosic biorefinery, lignin-based products and additional applications resulting from biorefinery processes and the relevant bioeconomy chains via targeted knowledge and data transfer
- Ensure that the project results are taken up by decision-makers to influence policy-making, by industry to secure market uptake and sustainable growth of the bioeconomy
- Connect with the scientific community to ensure project follow-up
- Generate market demand for the products or services developed
- Contribute to skills development via trainings and seminars

The multitude of objectives already highlights the wide variety of stakeholder groups targeted by UNRAVEL, among them the scientific community and related projects, end users and industries, technology adopters, policy makers and regulatory bodies, EU-level knowledge groups and stakeholder platforms, other users of lignocellulosic feedstocks, environmental protection groups, as well as citizens and local residents of European bioeconomy regions. The detailed results of an in-depth stakeholder analysis are presented in Figure 1.

The intensity of stakeholder engagement activities and the exact formats vary during the different stages of the project as they depend on the knowledge and results that are generated during the different project phases.

Based on the work carried out to date, and as demonstrated by the outputs presented in this document, UNRAVEL is on track to meet the objectives of the stakeholder engagement strategy and set of planned activities. However, minor adjustments in stakeholder groups, timelines and/or engagement formats had to be made during the period from project M1 to M33 to adapt the stakeholder engagement strategy to the restrictions that have been put into place due to the Covid-19 pandemic to maximise the effectiveness of the performed activities.

These changes refer to the plans as set out in the GA:

- *Within this platform European project consortia from lignocellulosic projects are envisioned to gather once a year to discuss the status in the field, identify mutual needs, develop recommendations (e.g. for policy makers) on related issues, and discuss how in a concerted effort, this industry can be brought further. A first meeting will take place during month 6 on the occasion of the project meeting. (Inter-project knowledge exchange)*

As generated knowledge and results within the first two years of UNRAVEL were mainly related to progress in the FABIOLA™ biorefinery and ELEANOR pre-treatment processes, the potential for inter-project exchange was limited to the technical exchange and dissemination via scientific conferences and publications. As regards the

fruitful exchange with leading EU or national projects in wider subjects that surround lignocellulosic biorefineries, for example sustainability performances, impacts on the European bioeconomy or feedstock logistics, which were originally the target due to their relevance for knowledge exchange, deeper insights and shareable results started to become available after the first two years of the project.

During that period, due to the COVID-19 crisis, the project team was largely unable to organize meetings and to contribute to events where interaction with key stakeholders would have been possible. Therefore, a systematic stakeholder engagement as intended in the DoA has been impossible. Virtual meetings have been planned and performed instead replacing face-to-face meetings. However, delays were caused by various national lockdowns with home offices and the necessary internal re-organisation of project teams and industry partners targeted by UNRAVEL. This also resulted in the delayed submission of this deliverable report (D7.3 has been postponed from M28 to M33, as agreed with the PO).

For the second half of UNRAVEL more innovation related results are expected, as well as crucial knowledge on the life-cycle assessment and the overall sustainability performance of UNRAVEL. This comprises results on potential environmental impacts, techno-economic scenarios for industrially viable lignin-based value chains as well as business prospects and risks.

Stakeholder engagement events are already planned and dialogues have been initiated, which are described in detail in Chapter 5, Stakeholder engagement activities – M1-M33.

3. The UNRAVEL Dissemination, Communication and Exploitation Plan as guiding document

The project's Advanced Dissemination and Exploitation Plan/DEP during the first two years provided the basis for UNRAVEL stakeholder engagement activities by (i) outlining the overall UNRAVEL dissemination, exploitation and communication strategy, by (ii) providing the results of an in-depth stakeholder analysis, by (iii) defining the roles and responsibilities and (iv) by providing a work plan at task and stakeholder level, which has been continuously updated during the project course, making it a usable and living working document.

The DEP will serve as such a working document over the entire term of the project, to apply the strategy and principles outlined in the strategy to verified project results and outputs achieved during the term of UNRAVEL. This will allow for the systematic implementation of the UNRAVEL stakeholder engagement strategy throughout the project and beyond. The Advanced DEP will be updated regularly and includes detailed timelines, dissemination channels, exploitation roadmaps and selected events and networks at work package, deliverable and milestone level.

The first version of the Advanced DEP has been made available to and has been agreed by all partners on the 1st December 2018 (please also refer to project milestone MS12 'Advanced Dissemination, Exploitation and Communication Plan'). Based on this agreed version, the Advanced DEP has been continuously assessed and adapted as the project progressed until M18. An updated version of the DEP has been made available to the PO via the 1st Periodic Technical Report on the 10th April 2020.

The Advanced DEP during all project phases provides the framework of *what* type of knowledge is transferred and/or discussed *why*, to *whom*, *how* and *when* and defines the:

- Communication aims, target groups and appropriate formats;
- Strategy, content and timeline of the communication and stakeholder engagement measures;
- Roles and responsibilities for the implementation of activities;
- Evaluation concept for communication, knowledge exchange and engagement formats

The DEP ensures that all project partners have a joint idea and understanding of stakeholder engagement, the influence of IP protection measures on communication and exchange activities, and the legal requirements as laid out in the Grant Agreement.

4. Stakeholder engagement and knowledge transfer – implementation strategy

The stakeholder engagement and knowledge transfer methodology applied in UNRAVEL focuses on results and newly generated knowledge, ‘Knowledge Outputs’ of sorts, which are either units of knowledge (also data) generated in the scientific and technical work packages or refer to a more generic progress in knowledge by bundling results and knowledge units from different WPs into an improved understanding of lignin-based value chains, applications made possible via the valorisation of side products, sustainability performances of lignocellulosic biorefineries and impacts at societal levels. UNRAVEL knowledge units are captured at work package level and transferred internally for further processing in WP7. Management processes include the evaluation of knowledge and the selection either for immediate transfer and exploitation or for protection for future commercial exploitation.

The knowledge management activities underlying stakeholder engagement involve processing originally planned knowledge outputs - mainly the defined project deliverables – but also finding any additional knowledge generated and captured outside the official deliverables, so-called unexpected knowledge outputs, to assess them for their potentials for specific stakeholder groups.

The overall UNRAVEL knowledge transfer implementation strategy is based on four tasks performed in an iterative manner by TNO and the Dissemination Officer Rita Clancy (tasks are described in detail in 5. *Stakeholder engagement activities – M1-M33*), which are:

- Analysing the landscape of UNRAVEL stakeholders
- Collecting and understanding UNRAVEL knowledge and results
- Evaluating UNRAVEL knowledge and results
- Organising stakeholder engagement to transfer and discuss UNRAVEL knowledge and results

Main goal is to transfer and discuss selected knowledge with the various identified project stakeholder groups who have the interest and the capacity to uptake UNRAVEL knowledge, who hold knowledge relevant for UNRAVEL, to create synergies with project concepts and/or to utilise or further share it with the wider knowledge community. In this context it is important to, besides assessing the UNRAVEL knowledge and results, analyse the profiles of stakeholder groups to understand their knowledge requirements and the suitable channels and formats for engagement and transfer of knowledge outputs (e.g. via personal conversations, engagement via workshops/conferences, participation in project-external meetings, round tables or others).

During the first thirty-three months, the work package leaders in UNRAVEL collected and assessed the knowledge generated in the WPs 1-6, stored the knowledge in respective templates and internal documentation, analysed and evaluated the knowledge for further processing, and analysed the WP-relevant stakeholder group landscape for their knowledge requirements and suitable channels through which knowledge can be transferred.

Together with the project Coordinator, TNO, and all private sector partners who are mainly responsible for exploiting UNRAVEL outputs, knowledge and results have been assessed with regards to their innovation level and marked for IP protection where relevant.

5. Stakeholder engagement activities – M1-M33

5.1. Analysing the EU stakeholder group landscape and its requirements

A thorough stakeholder analysis has been performed by EURIDA, building on the initial stakeholder analysis’ results from the UNRAVEL project development phase.

A wide range of stakeholder groups has been identified to be of relevance for UNRAVEL knowledge and results. Those groups comprise different scientific areas and/or applications, such as ‘Lignocellulosic Biomass’, ‘Lignocellulosic Biorefineries’, ‘Bioeconomy’, ‘Lignin-based applications, the UNRAVEL key market segment ‘Construction sector’, ‘End-users of high-quality lignin outside the construction sector’, and ‘Other end-users’, e.g. for hemicellulosic sugars, extractives (e.g. betulin), etc.

In addition, policy makers, regulatory bodies, such as national licensing bodies, and standardisation bodies, such as CEN and CENELEC (for future implementation of standards) have been identified to be relevant actors for engagement and/or two-way knowledge exchange. On the one hand for UNRAVEL to meet existing regulations and in the fields of bio-based products respectively, but also for sharing UNRAVEL results and ideas for possible future licensing schemes and standard setting for lignin-based applications.

The identified stakeholder groups have been refined by means of an adopted SWOT analysis (Figure 1: The UNRAVEL Stakeholders) with the goal to distinguish between key stakeholder groups, direct target groups, such as multipliers and groups for open discussions, possible facilitators or risk groups and potentially interested parties and adopters of UNRAVEL results for application fields beyond the target area of construction.

Based on this pre-selection, the EU stakeholder groups' profiles have been analysed in more detail, so knowledge and results generated during the course of UNRAVEL, once collected, could be put against the knowledge requirements and specific areas of interest of each specific stakeholder group.

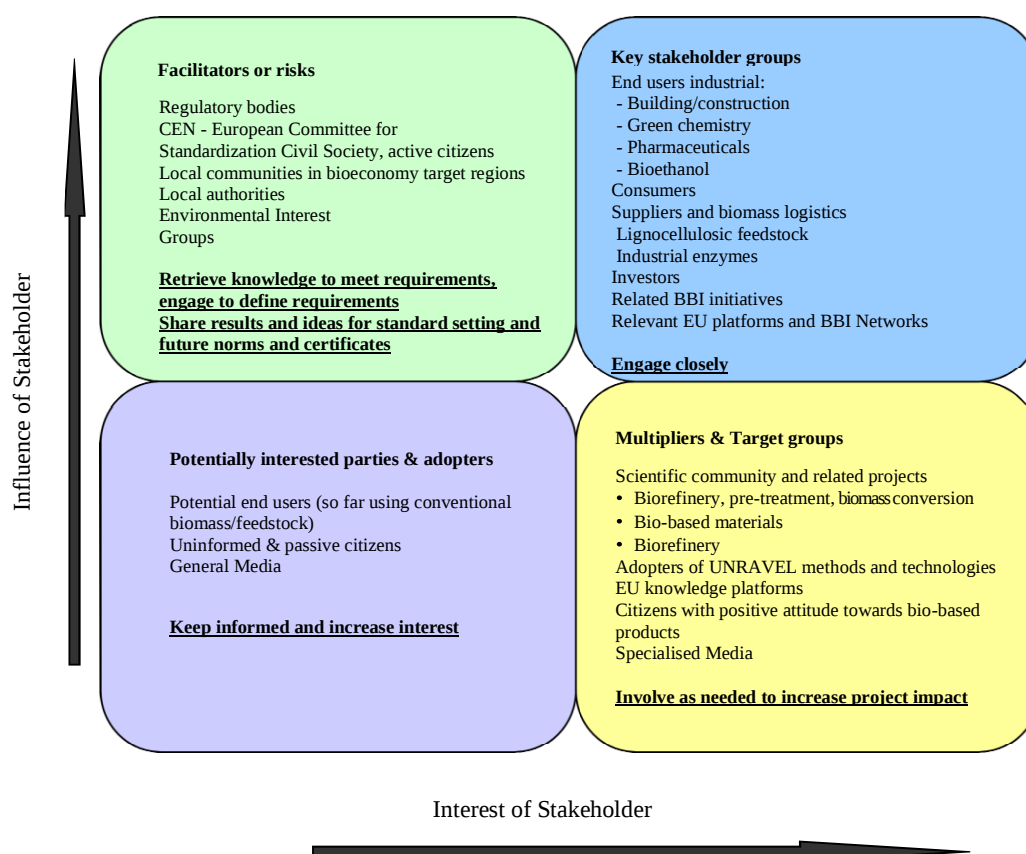


Figure 1: The UNRAVEL Stakeholders for engagement formats

5.2. Collecting and assessing UNRAVEL results and knowledge

During the project period of M1-M33 work package leaders have been requested to identify and report the knowledge and results generated in their respective WPs regularly, starting in Month 1 of the project. Formats in which knowledge and results were stored and reported were either official deliverables reports and/or internal progress reports. All partners were furthermore requested to identify any knowledge and results that could be of importance for stakeholders, even if they are not of direct interest for further UNRAVEL project tasks or exploitation activities.

Based on the reports, TNO as responsible partner, supported by the Dissemination Officer then performed an initial review on whether:

1. The reported knowledge and results were consolidated and verified (e.g. was underlying data available, were results reproducible etc.)
2. The knowledge and results descriptions were comprehensible, applicable and understandable for stakeholders that are non-experts;
3. Conflicting results and knowledge existed within or outside the project that would have to be addressed;
4. Details were missing or unclear so that knowledge and results could be described in a more comprehensive manner before being evaluated for the transfer to selected stakeholders;

As a result of these analyses steps, a first internal knowledge and results repository has been built for further evaluation with regards to potentials and restrictions in knowledge transfer towards above listed stakeholder groups.

5.3. Evaluating Knowledge and results for transfer and stakeholder engagement

During the evaluation activities all reported knowledge and results stored in the internal knowledge repository have been assessed with regards to their suitability for being shared and discussed with selected stakeholder groups. The wider goal of all knowledge evaluation activities was twofold:

- To generally identify UNRAVEL knowledge and results of interest for the respective stakeholder groups;
- To identify those knowledge outputs and results that had to be treated as confidential, due to IP protection for future commercial exploitation.

Once the knowledge outputs had been separated into 'public' and 'confidential', the knowledge evaluation has been continued under more detailed aspects, such as:

- Which specific stakeholder groups would benefit from what type of knowledge and which specific project results?
- Which topics and knowledge fields exist which UNRAVEL requires input from specific stakeholder groups
- Which engagement formats would be most suitable to reach each selected group?
- How could the knowledge and results shared and/or retrieved in engagement activities be effectively stored and made publicly available in the longer-term to assure the sustainability of engagement efforts?

5.4. Stakeholder engagement activities towards specific stakeholder groups

Work performed and results gained during the stakeholder analysis and UNRAVEL knowledge evaluation revealed that during the first 24 project months the knowledge and results that have been generated were mostly suited for targeted knowledge transfer with the scientific and technology community active in biorefinery and biomass conversion.

Therefore, stakeholder engagement so far has been mainly performed via channels and formats that are most suitable to reach a large part of the community and convey and discuss scientific knowledge and results that, after checked for IP, was assessed as 'public'. Those channels and formats were mainly conferences, scientific publications and the UNRAVEL online and social media presence.

While conferences and publications mainly reached the scientific and technology community, UNRAVEL social media activities further allowed targeting and involving a wider range of stakeholders.

5.4.1. Engaging with the scientific and technology community via conferences and publications

Table 1 summarises the conferences at which UNRAVEL partners engaged with the science and technology community (incl. industry active in technology research and innovation) and the scientific publications that resulted from the project between June 2018 and February 2021.

Table 1 Overview of conferences, events and publications as part of UNRAVEL's engagement with the science and technology community.

Conference	Target	Participant(s)
2018-2019		
High Value Chemicals from Plants - Annual Meeting 2018 1st Oct 2018 in London/UK;	Science Industry	Celignis – Oral presentation: "Extractives in residues from the forestry sector and their influence on biomass pre-treatment processes."
International Biogas Congress and Expo 2018 10th-11th Oct 2018 in Berlin/Germany;	Science Industry	Celignis – Oral presentation: Presentation: "How Lab-Scale Process Optimisation can Lead to Large-Scale Efficiency Improvements."
Pitch perfect and boost the European bio-economy 7th November 2018 in Brussels/Belgium	Science Industry	Celignis – Oral presentation: Presentations: "With Accurate Data the Opportunities are Limitless." by Celignis
Novel Technologies for Resource Recovery from Biomass and Organic Residues 25th April 2019 in Galway/Ireland;	Science Industry	Celignis - Oral presentation: "How to Match Feedstock and Technology for Effective Resource Recovery."
EUBCE 2019 27 th -30 th May 2019 in Lisbon/Portugal	Science	1. TNO - Poster presentation: Fractionation of lignocellulosic biomass and downstream processing for bio-based chemicals and building materials.; 2. TNO - Oral presentation: Development of a pre-extraction process for improved acetone organosolv fractionation of complex lignocellulosic biomass. 3. MetGen - Oral presentation: Alkaline laccases for lignin valorisation.
Biobased Industry Opportunities in Horizon 2020 22nd May 2019 in Limerick/Ireland	Science Industry EU Projects	Celignis - Oral presentation: "Experiences of an SME in Spinning Out from EU Research and Participating in H2020 Projects."
Batimat Trade Fair 4th-9th Nov 2019 in Paris/France	Industry	Soprema - booth with presentation of samples of lignin based PUR/PIR foams and bio-based bitumen. By SOPREMA

Woodchem 2019 20 th -22 nd Nov 2019 in Nancy/France	Science Industry	Soprema - Oral presentation: "From lignin to PU insulation foams: An industrial success story" (incl. UNRAVEL concept and applications of UNRAVEL lignin).
BBI JU Stakeholder Day & Forum 3rd – 4th Dec 2019 in Brussels/Belgium	Science EU Projects	TNO & Celignis - Project booth with roll-up, brochures/flyers and first UNRAVEL lignin samples.
2020		
e-EUBCE 6 th to the 9 th July 2020, Virtual Event	Science	TNO - Poster presentation: " Production of Bio-Based Building Materials from Lignin of Lignocellulosic Biomass Residues."
LIBERATE workshop, Innovative solutions to valorize lignin 30 th June 2020, Online	Science Industry	Fraunhofer CBP – Oral presentation: Pilot-scale FABIOLA™ lignin production and valorization
Note: Due to the COVID-19 restrictions and the related cancellations or postponements of relevant events the participation in scientific conferences by the UNRAVEL consortium has been very limited.		
Scientific Publications (peer-review)		
Duval A., Avérous L. (2020): <i>Mild and controlled lignin methylation with trimethylphosphate: towards a precise control of lignins functionality. Green Chem. DOI: 10.1039/c9gc03890f.</i> The article was published on the 14 th February 2020.		
Duval A., Layrac G., van Zomeren A., Smit A., Pollet E., Avérous L (2020): <i>Isolation of Low Dispersity Fractions of Acetone Organosolv Lignins to Understand their Reactivity: Towards Aromatic Building Blocks for Polymers Synthesis. ChemSusChem 2020, 13, 1-12. DOI: 10.1002/cssc.202001976</i> The article was first published on the 2 nd October 2020.		
Based on the "very positive referee reports" and as it is "likely to address wide interest in the chemistry community" the article was published as "Very Important Paper".		

5.4.2. Inter-project knowledge exchange and engagement with related initiatives

As outlined in Section 2, *Progress towards objectives* (p. 6 ff.), knowledge and results within the first two years of UNRAVEL were mainly related to progress in biorefinery, the pre-treatment and fractionation of lignocellulosic biomass and progress in the downstream processing steps. Therefore, the potential for inter-project exchange was limited to projects on these topics. As highlighted in section 2, project partners in leading projects are either members of the UNRAVEL consortium (Table 1) or direct competitors for future exploitation, which therefore were and will be excluded from engagement activities.

From M24 onwards, more innovation related results and knowledge were and will be generated by UNRAVEL.

Overall, the knowledge outputs that can be expected have been screened ex ante, based on project work plans and internal status reports. Based on this assessment, there are three priority topics that will be most promising for stakeholder engagement and/or that need intense stakeholder dialogues due to knowledge or inputs required by UNRAVEL:

Table 2 Knowledge outputs and topics that are most relevant for stakeholder engagement

Topic	Action	Target Groups
Topic #1: Overall UNRAVEL cascading concept for lignocellulosic biorefinery. Subtopic #1.1: Future integration of UNRAVEL processes in sustainable industry-scale plants and biorefineries Subtopic #1.2: Improving the overall sustainability of lignocellulosic biorefinery	A. Meetings for knowledge exchange and for developing future concepts with relevant projects and initiatives B. Develop public fact sheets and open databases for wider stakeholder groups	Biorefinery <u>Biotechnology sectors</u> <u>Climate and sustainability community</u>
Topic #2: Biomass supply chains, logistics and improved access to feedstock and wood resources for lignin applications; Subtopic #2.1: Type of resources and feedstocks deployed for the UNRAVEL value chains; Subtopic #2.2: Outlook on environmental, socio-economic and overall sustainability performance Subtopic #2.3: How can novel lignin value chains and the valorisation of extractives and biorefinery side-streams improve overall biomass use and forestry and agricultural management concepts	A. Meetings with relevant projects and initiatives B. Include biomass suppliers and experts in UNRAVEL for systematic knowledge exchange	<u>Biomass suppliers</u> <u>Logistics experts in bio-based value chains</u> <u>Sustainability community</u>
Topic #3: Results and recent developments on high quality lignin, extractives and hemi-cellulosic sugars as biorefinery products and high value applications Subtopic #3.1: Novel applications from high quality lignin, esp. in the construction sector (bitumen, polyols, PU/PIR) Subtopic #3.2: Valorisation of extractives, e.g. botulin, for the phramaceuticals and green chemistry sectors Subtopic #3.3: Valorisation of hemi-cellulosic sugars for bio-ethanol	A. Meetings with relevant projects and initiatives B. Include industrial stakeholders and end users for systematic knowledge exchange	<u>Manufacturers bio-based products</u> <u>Chemical sector</u> <u>Pharmaceutical and cosmetics sector (esp. for betulin as extractive from birch)</u>

The topics and results that have been identified to be of strongest interest for targeted knowledge exchange, as listed above, further built the basis for inter-project communication. UNRAVEL initiated contacts with coordinators and/or partners from related projects, building the fundament for continuous knowledge exchange during the final phase of the project. Table 3 summarises the action performed so far and the projects and initiatives that the action has been targeted to.

Table 3 UNRAVEL Inter-Project Exchange – Topics and action performed

Topic	Target Project(s)
Topic #1: Future integration of FABIOLA™ in LIBERATE projects's pilot scale electrochemical plant concept for zero CO ₂ processing and improving the overall sustainability of lignocellulosic biorefinery	LIBERATE (funded by Horizon 2020/SPIRE) www.liberate-project.eu
Action performed: - Two meetings were held to assess commonalities of both projects, possibilities for the improvement of each project concept respectively, and the potential of future integration of UNRAVEL and LIBERATE concepts, especially for improving the sustainability of lignocellulosic biorefinery. - First discussions were held about possible future dissemination and communication action, including developing joint public fact sheets and organising workshops. Results achieved so far: In general, it is interesting for UNRAVEL that other options for Fabiola lignin are explored in LIBERATE and that this also helps the UNRAVEL impact. Four specific results were obtained from the technical exchange meeting: - Lignin characteristics of organosolv lignin (both from ethanol and acetone organosolv processes). TNO indicated that there are two papers that describe and compare lignin characteristics and they will be circulated. - Techno-economic analysis of ethanol organosolv lignin and the electrochemical conversion in the SINTEF pilot plant will be done in LIBERATE. The data from the TEA of ethanol organosolv is highly interesting for UNRAVEL (base case TEA in WP6). The LIBERATE consortium will decide (consortium meeting March 2021) if this information is regarded non-confidential. TNO will be present in that meeting to explain the interest from the UNRAVEL consortium. - Possible potential of combinations of electrochemical and enzymatic depolymerization technologies for enhanced product yields in LIBERATE value chains and/or newly developed value chains. This result will be discussed with UNRAVEL partner MetGen and will be followed up when MetGen agrees. - Assessment of the future energy mix to be used in the TEA/LCA approach within LIBERATE. This result was based on technical discussion between sustainability experts from both projects and the exchange/advice was of direct benefit to LIBERATE. The first technical exchange was of value for both the LIBERATE and the UNRAVEL partners and it was agreed to have a further exchange of non-confidential results later on in the projects when more results from the TEA and the LCA analysis is available. In addition, the potential combination of enzymatic and electrochemical depolymerization of lignin might lead to further technical discussions.	
Topic #2: Opportunities for lignocellulosic biorefinery emerging from utilising marginal lands for feedstock production (miscanthus);	GRACE BBI (funded by BBI JU) www.grace-bbi.eu MAGIC Project (funded by Horizon 2020) www.magic-h2020.eu
Action performed: UNRAVEL partner IFEU, partner in both targeted projects, assessed preliminary results achieved by MAGIC on the economic feasibility of industrial crops grown on marginal lands that could be of interest for a lignocellulosic biorefinery. GRACE BBI partner University of Hohenheim was contacted by UNRAVEL to discuss mutual benefits that could arise from using miscanthus produced on so far unused land for lignin value chains as targeted by UNRAVEL.	

Results achieved so far:

The UNRAVEL partners came to the conclusion that it is generally positive to have a larger feedstock base for a biorefinery as developed in UNRAVEL. In this regard, contacts to partners from MAGIC and GRACE BBI are valuable. However, biomass residues should clearly be given priority over cultivated biomass, even if it comes from marginal land that would otherwise be unused. From an economic perspective, the cultivation of industrial crops is generally more expensive on marginal land compared to standard land e.g. because of biophysical constraints that require higher fertilizer and other inputs per tonne of harvested biomass or because of remote/spread out location that requires more working hours. Despite national and EU subsidies for cultivating marginal land, most of this land has remained unused because biomass cannot be produced at competitive prices. This makes it less attractive as main feedstock for UNRAVEL but could still be interesting as addition. From an environmental perspective, crops from marginal land are not clearly better than crops from standard land. Marginal land often leads to higher impacts from fertilizer and fuel consumption etc., can have high impacts on local biodiversity because many areas with above-average biodiversity are on marginal land but has a low risk to cause indirect land use change. So it depends on site and crop if such feedstock would be environmentally acceptable for an UNRAVEL biorefinery.

For these reasons, biomass cultivated on marginal land could be a valuable addition to a feedstock portfolio mainly consisting of underutilized residues if economic and environmental boundary conditions are favorable. Maintaining contact to partners from MAGIC and GRACE-BBI is aimed for but is not top priority.

Topic #3: High quality lignin, its properties and possible valorisation options (esp. using enzymatic depolymerization and characterization)

Woodzymes (funded by BBI JU)
www.woodzymes.eu

Action performed:

First discussions on topics and knowledge for exchange were held with the coordinator and experts of the Woodzymes project. In this stage, it was chosen to only share non-confidential information on both projects and to wait if there would be a need to install an NDA at a later stage. The participants found the exchange meeting (24-02-2021) interesting and several concrete actions have been defined. The following six subjects were discussed and found to be of mutual interest:

1. METNIN lignin depolymerization to reveal fractions with different properties and how to judge which properties are suitable for the different applications.
2. Use of hemicellulose sugars as paper-making additives.
3. Use of lignin-based polyols for PUR foams using oxypropylation
4. Comparison of lignin characteristics from Kraft lignin and organosolv lignin
5. UNRAVEL industrial stakeholder panel
6. Potential exchange of LCA aspects from UNRAVEL and WOODZYMES

Further exchange will initially take place bilateral (see actions) and another plenary meeting might be organized later this year. The experts have learned new aspects of lignin valorisation and identified interactions to explore alternative applications for lignin. In addition, the exploitation potential for the METNIN technology might be helped if we could find possibilities to exchange samples for application testing of one of the METNIN fractions towards the phenol-formaldehyde resins.

Further inter-project communication is focused on the scientific exchange between projects that UNRAVEL partners are involved in. Among those projects SWEETWOODS (wood fractionation demo plant for hard wood biomass as raw material for sugars and high quality lignin; partner MetGen), BIOFOREVER (Bio-based products from wood biomass; partner MetGen), BECOOL (Brazil-EU cooperation on sustainable value chains for lignocellulosic advanced biofuels, partner: TNO).

In addition to the inter-project exchange described above, TNO introduced the FABIOLA™ mild organosolv fractionation process that will be upscaled by UNRAVEL in the EU COST Action ‘LignoCOST’ as part of Working Group 2: Production and catalytic conversion technologies. It has been listed in the overview of promising fractionation methods to produce lignin.

Further knowledge transfer is planned for the following project period. The results from the lignin application testing that are expected by UNRAVEL before the next LignoCOST meeting in September 2021 are of particular interest. Some other initiatives for knowledge exchange did not lead to concrete engagement, largely due to an insufficient fit of activities after initial discussions. This relates to the projects TECH4EFFECT and NOVUM.

5.4.3. Engagement with industrial stakeholders and end-user representatives

Direct knowledge exchange and engagement with industrial stakeholders and future end users via meetings has mainly been implemented via an Industrial Stakeholder Panel, which includes selected representatives from the various lignin application and the biomass supply sectors.

During the second phase of UNRAVEL a Stakeholder Panel has been established which comprises, as one of two sub-units, the **Industrial Stakeholder Panel**. It includes partners from the industry and end users as well as manufacturers relevant along the UNRAVEL value chain.

Members of the “Industrial Stakeholder Panel – Market End Users” are:

- **EIFFAGE** (www.eiffage.com): Market leader in pavings. Possible valorisation of lignin in bitumen without competition with key exploitation partner SOPREMA or other UNRAVEL partners.
- **Polybridge** (www.polybridge.com): Consultancy for innovation strategies and valorisation in wood chemistry and polymer products.
- **SOPREMA** (www.soprema.fr): One of the world leaders in insulation and roofing materials, using lignin as compound for PU/PIR and bitumen. SOPREMA is industry partner in UNRAVEL and also participates as expert in the Industrial Stakeholder Panel.
- **SAPPI** (www.sappi.com): Sappi is a large company in the pulp and paper industry. They are interested in alternative products from the feedstocks they normally use and the valorisation of cellulose, hemicellulose and lignin towards different end-users.
- **ARKEMA (not confirmed yet)**
- **COVESTRO (not confirmed yet)**

5.4.4. Engagement with biomass suppliers and logistics stakeholders

One group of key stakeholders that during the first two years of UNRAVEL have been identified as crucial for future industry-scale lignocellulosic value chains are biomass suppliers and experts in biomass logistics. Therefore, as second subunit of the UNRAVEL Industrial Stakeholder Panel, the **Biomass Supplier & Logistics Panel** was set up. It includes partners from the biomass supply side as well as public authorities at national and European levels.

Members of the “Industrial Stakeholder Panel – Biomass Suppliers & Logistics” are:

- **Staatsbosbeheer - Dutch Forestry Management Agency** (www.staatsbosbeheer.nl): Staatsbosbeheer is a Dutch public institute that protects, maintains and develops the Dutch nature (270.000 ha forest, nature areas and typical landscapes). They are interested in the valorisation of forestry residues and other residues coming from their activities. They have a good overview of the feedstock market and can indicate the needs from their perspective.
- **European Forestry Institute/EFI** (www.efi.int): An international organisation established by European States that, among other activities, addresses policy-relevant issues at a pan-European or regional level, analyses and upscales information on forest resources, products and services on a pan-European level, and supports the coordination, strengthening and networking of forest research capacities aiming to overcome the fragmentation of European forest research.
- **Italian Biomass Association/ITABIA** (www.itabia.it): An Italian network promoting the local transformation towards a sustainable bioeconomy, using renewable resources, such as agricultural biomass and residues for bio-based products and bioenergy.

First online meetings were organised in January/February 2021 with both sub-units of the Panel individually, during which the UNRAVEL concept has been introduced. Topics for future discussions have been identified and a second meeting with the whole stakeholder panel will be planned in March 2021 (after the NDA is signed by all).

5.4.5. Engagement with the wider public and citizen stakeholders

To assure a wide interest in UNRAVEL beyond the scientific and industrial technology communities project results and concepts have been embedded in a wider context, which included future applications of societal impact that will be enabled based on our project’s progress. Key messages have been formulated with the support of all consortium partners. We put a particular focus on non-technical easy-to-understand language to convey the bigger picture to the general public and interested citizens from various backgrounds. We assessed press releases to popular science media and multiplier organisations and our dedicated UNRAVEL social media channels to be well suited for delivering the messages to such a wide audience. If the COVID-19 restrictions allow it, social media campaigns will in the future be complemented by events, such as Open Days at partner organisations, to engage with the general public. Other formats that are planned to reach wide stakeholder groups, including citizens, are listed in chapter 5.5.

Table 4 summarises the key messages and online campaigns targeted at a wider public until project M33.

Table 4 UNRAVEL key messages and online campaigns for a wider public

Key Message	Campaign/Timeline
#1 ‘Birch bark for pharmaceuticals’ UNRAVEL developed an improved isolation method from birch bark, which is less complicated and more environmentally benign than current methods. This could help the pharmaceutical sector in developing products for the skin, based on betulin’s anti-oxidant and anti-inflammatory properties. Current studies further indicate the prospects of betulin as anticancer agent.	2020 4 posts on: Twitter LinkedIn Linked to: UNRAVEL project website (extended post)
#2 ‘Reducing forestry and agricultural waste by using branches, bark etc. for high value products’ UNRAVEL utilizes forestry and agricultural residues, such as tree branches, bark, roadside grass and straw for developing high value lignin based products for the construction sector. Aim is to replace so far fossil-based products, such as bitumen and PUR, without increasing competition over hardwood or agricultural feedstocks for applications that cannot use residues for various reasons. Utilising agricultural residues will further prevent unwanted conflicts of bio-based products and materials with food and feed.	2019-2020 6 posts on: Twitter LinkedIn + Visuals of UNRAVEL feedstock concept: Overview graphic Photos of mixed feedstock used for pilot line @Fraunhofer CBP
#3 ‘Driving on bark, building with nutshells’ UNRAVEL will demonstrate a sustainable and economically feasible biorefinery for the conversion of 2 nd generation biomass into green chemicals and building materials. One of the major challenges in creating long-term benefits is to find sustainable and industrially viable biomass that does not compete with land-use for food production or that could pose the risk of natural habitat loss. One promising solution lies in using biomass residues that originate from forestry and/or agriculture such as bark, wheat straw or nutshells. To make a lignocellulosic biorefinery economically feasible and to be able to use all valuable components that are present in a certain feedstock an efficient integrated biorefinery process is required. In UNRAVEL the mild biomass fractionation process FABIOLA™ (patented by project coordinator TNO/Netherlands) is applied, further matured and upscaled to prove its applicability for the industry. With its breakthroughs UNRAVEL will make a strong contribution towards the EU goal of a bio-based economy that supports the transition towards a post-petroleum society while decoupling economic growth from resource depletion and negative environmental impacts. The project holds potential for a significant reduction of operating cost and energy demand, which will equally benefit the economy and the environment.	2018-2019: 4 press releases (2 on the overall concept; 2 on first scale-up results, both in English and German) 12 posts on: Twitter LinkedIn Facebook

5.5. Knowledge Transfer activities – Outlook from M33 onwards

Based on the results of the stakeholder group analysis and the foreseeable knowledge outputs and results that will be generated between month 24 and 48 of UNRAVEL intense knowledge transfer activities with various stakeholder groups and the wider knowledge community are planned.

A list of currently targeted activities, planned engagement formats and timelines for coming activities between M33 and M48 are summarized in Table 5 below.

Engagement activities that are added to the action plan after this report and/or planned for the final year of UNRAVEL will be added and updated in the UNRAVEL Advanced DEP.

Table 5 Summary table of planned knowledge transfer activities towards EU stakeholder groups

Action	Partners involved	Target Group	Planned Timeline/ Status
Stakeholder engagement via conferences and meetings – Scientific community and industry			
Conference Participation			
EUBCE 2022	TNO	Scientific community, industry	April 2022
Presentation in biorefinery workshop at the Sardinia symposium on waste management	TNO	Scientific community, industry	October 2021
LignoCOST (EU COST Action)	TNO	European Lignin Expert Community	September 2021: Introduction of the UNRAVEL lignin application testing results
Stakeholder engagement via Policy Briefs and planned follow-up discussions			
Policy brief: “Sustainability and techno-economic feasibility of the UNRAVEL lignocellulosic value chain.”	IFEU TNO	Policy Makers, Scientific Community	Available in April 2022
Policy brief: “Optimised biomass supply chains for a European lignin-based bioeconomy”.	TNO UNRAVEL Industrial Stakeholder Panel – Biomass Suppliers & Logistics ??	Policy Makers, Scientific Community	Available in May 2022
Series of Fact Sheets (extracts from deliverable reports and policy briefs in non-technical language)	Eurida All partners	Wider public Various stakeholders	Available in May 2022
UNRAVEL Stakeholder Events & Workshops			
1 st Stakeholder round-table on biomass availability, supply chains and logistics	TNO, EURIDA Industrial Stakeholder Panel	Industry, Policy Makers	April/May 2021 ?? (planning in progress)

1 st Stakeholder round-table on lignin valorisation paths and market applications	Soprema MetGen Industrial Stakeholder Panel – Market End-Users	Scientific Community, Industry Policy Makers	April/May 2021 ?? (planning in progress)
Knowledge transfer towards EU stakeholder groups	EURIDA, TNO IFEU	EU knowledge community	Knowledge identified and channels established by Dec 2021

6. CONCLUSIONS

The stakeholder engagement activities carried out within the UNRAVEL project are designed to maximize the project's impact and to facilitate the uptake of results and newly generated knowledge by all stakeholder groups. During the first project period between M1 and M24 the generated knowledge and results have either not been found suitable for transfer and engagement towards stakeholders besides the scientific community or was found to be subject to IP protection.

The ground for more intense engagement with wider stakeholder groups has been paved with a comprehensive set of events planned for the coming stages of the project, as more innovative knowledge and results with relevance for policy makers, industrial stakeholders and citizens will become available.

Based on the stakeholder engagement activities performed so far and based in the evaluation of preliminary results and knowledge outputs as well as existing knowledge gaps and potential risks and future market barriers that are of relevance, we have come to the conclusion that the topic of securing a solid biomass supply chain and sound feedstock logistics is one of the most important areas for intense stakeholder engagement.

Another pressing topic for stakeholder action, especially with the private sector, is to identify the most promising applications for UNRAVEL lignin and related market prospects and risks that future market actors should be aware of.

The importance of both above-listed topics to support a strong bio-based economy and the necessity to engage with relevant stakeholders has lately been confirmed by the BBI JU in their Annual Work Plan (AWP) 2021. In line with the Strategic Innovation and Research Agenda (SIRA), the AWP 2021 confirms the commitment to strengthen the participation of biomass feedstock suppliers in the value chain. BBI JU further will encourage partnerships with end-market actors to create a market pull for bio-based products.

In UNRAVEL, based on our stakeholder engagement strategy and hands-on action, we strongly contribute to these strategic goals as set out by BBI JU.



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