

SIMPLI-DEMO

DEMONSTRATION OF SONICATION & MICROWAVE
PROCESSING OF ESSENTIAL CHEMICALS

D6.1 Web platform

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Dissemination Level

Public



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1. Executive summary

Communication and dissemination is one of the crucial elements of the SIMPLI-DEMO project and is deployed throughout the whole project duration. It targets the relevant and potentially interested communities, both in countries where the consortium partners are operating and on the European level.

A project website, which is hosted via TU Dortmund, was set up aiming to represent the first vehicle in raising awareness of the project and containing a general presentation of the project objectives and the consortium as well as all public information related to the project activities, results, events etc.

Throughout the duration of the project, the website will be constantly updated with information about the project's progress and outcomes. In this way, awareness of the project's goals and intentions is increased and a more in-depth discussion of the project's dissemination activities (publications, conferences, etc.) is promoted.

2. SIMPLI-DEMO Website

2.1. General description

The first full version of the public SIMPLI-DEMO website (<https://www.simpli-demo.eu>), is available since December 2022 as a tool for dissemination of up-to-date information on the project. The website contains a general presentation of the project objectives and the consortium as well as all public information related to the project activities, events, results and networks. With this combination of general and specific project information the project website targets all relevant audiences including the general public, research communities, and industrial end-users.

The SIMPLI-DEMO website will be regularly updated all along the project lifetime with the latest results and findings. Further information material will also be published on the website. This includes in particular general project flyers and scientific publications. The promotion of the SIMPLI-DEMO project will also be done through other web portals like [LinkedIn](#), [Twitter](#) and Instagram in order to create synergy effects. The respective social media accounts are linked via the website.

The public area of the website provides the following pages and information:

- **Homepage:** general information about the project, including the intentions of the project and the location in the EU funding / the funding call;
- **About:** general project information and approach // reference to the innovation activity of the project, which aims at the market introduction of new modular flow technology // reference to the 13 consortium partners from industry, academia and consulting // short facts about the project // main project idea and objectives technical framework details on the approach of the project // work plan (including work packages and time line);
- **Partners:** short presentation of the consortium (*Figures 2-6*);
- **Case studies:** Basic information about the case studies and its embedding into the project;
- **Outcomes:** in the future downloads of promotion materials, publications and public deliverables;
- **News & Events:** list of events with links and downloads (*Figure 5*);
- **Contact & Newsletter:** coordination and management contacts and information on how to subscribe to the SIMPLI-DEMO newsletter, which will be published every six months for the duration of the project (*Figure 6*).

2.2. Website structure

In the following, the six main tabs of the SIMPLI-DEMO website are briefly introduced and presented in their graphic structure. The function and intention of each category will be briefly discussed in order to illustrate the role that the items will play in the public presentation of the project. Figure 1 gives an overall view of the website structure.

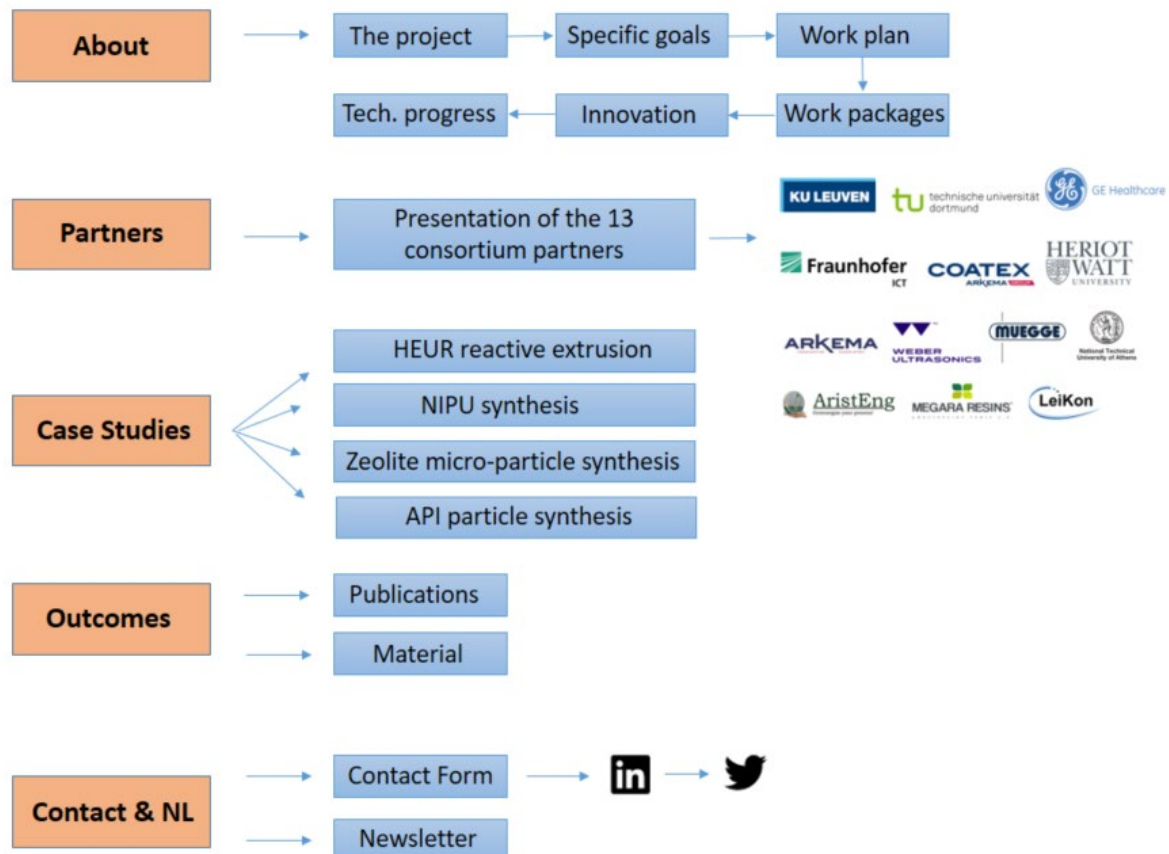


Figure 1: General structure of the website

2.2.1 Homepage



Figure 2: Project homepages start page

The homepage gives a short introduction to the project. The organizational framework of the project within the EU funding and the rough field of work of the research project are presented. Via the menu view, which is displayed at the top and bottom of the web page, in-depth information is displayed under the respective tabs.

2.2.2 About

Under the tab "About", which appears first in the menu overview, more detailed information about the project is provided. This includes first of all general information and short facts about the project. The first section, "The project", briefly outlines the project's mission in terms of content.

About

Objective and claim of SIMPLI-DEMO

THE PROJECT

SIMPLI-DEMO – *the Demonstration of Sonication and Microwave Processing of essential chemicals project* – aims at strengthening the **chemical process industry** and in particular the specialty chemicals and pharmaceuticals industries in its capacity to produce materials and chemicals in a sustainable and competitive way.

This contribution is made by moving **from batch to continuous and modular production** with flexibility being ensured by the application of alternative energy forms. Currently, the conventional technologies in the specialty and pharma sector tend to be batch-type, combined with mechanical mixing and conduction-based heat transfer, inherently leading to poor process control. SIMPLI-DEMO's vision is that of intensified processes, where alternative energy sources enable continuous and modular technologies to achieve localized actuation of multiphase, flow reactors for the purpose of **high-value product synthesis**.

SIMPLI-DEMO focuses on the **synthesis of specialty polymers and particles** for use in a wide variety of every-day-use products, e.g. insulation, paints and coatings, plastics, catalysts, as well as health applications, which are important domains in the chemical industry today and into the future. Therefore, SIMPLI-DEMO advances the **technology readiness level (TRL)** of modular flow technology for multiphase streams involving suspensions or viscous products from TRL5 (validation in relevant environment) to TRL7 (industrial system demonstration).

The consortium is composed of **13 partner institutions**. It consists of four end user chemical companies, two technology suppliers (ultrasound and microwave technology), five universities and research institutions (process control & automation, reactive extrusion, oscillatory flow, ultrasound, microwaves), one SME experienced in modular automation and another SME experienced in sustainability assessment and exploitation.

SHORT FACTS

Start Date: 1st October 2022

Duration: 48 months

Partners: 13 partners from academia, industry and consulting experts from 7 Countries

Budget: 9.4 million EUR

Coordinator: Prof. Tom Van Gerven, KU Leuven

Administrative Management: TU Dortmund

Figure 3: About – section “The project”

In the second section, the exact objectives of the project are explicitly highlighted. In this way, it is also indicated which instruments the project uses and which benefits are associated with the project results. Thus, potential interested parties of the project results are made aware of the impact of the project.

Specific goals of the project

SIMPLI-DEMO's ambition is to present the first pilot-scale system prototype demonstration for the long-term uninterrupted modular flow operation of solids-laden and viscous phase containing liquid process streams allowing for decentralized production. We want to achieve this by combining continuous flow equipment (REX, COBR) with the alternative energy forms of ultrasound and microwaves as process enablers for the transition from batch to continuous.

The results of this project will revolutionize the way the chemical industry currently approaches the process intensification of complex multiphase processes, by overcoming the technical barriers hampering continuous flow processing. No scale-up of this extent and breadth in the field of ultrasound- and microwave-assisted continuous chemical processes has been validated and demonstrated so far.

The objectives of the project are:

- Optimize and validate continuous multiphase reactions that involve solids or viscous phases in modular process equipment, based on prior validation in the lab.
- Design, validate and demonstrate pilot-scale intensified reactors that efficiently integrate modular flow technology.
- Develop and implement efficient process control and innovative automation strategies based upon Process Analytical Technologies (PAT) for modular, flexible continuous plants with actuation by alternative energy inputs.
- Assess the sustainability and techno-economics of the intensified processes compared to current industrial practice.
- Evaluate the potential adaptability, exploitation and multiplication of the developed technologies in other industrial processes and sectors.

500 years ago till now

Conventional processes:

- Batch and CSTR
- Large reactors
- Mechanical mixing
- Heat transfer by conduction
- Limited process control

↓

Low resource efficiency

Intensified processes:

- Continuous flow
- Alternative energy sources (e.g. microwaves, ultrasound)
- Non-mechanical transfer
- Precise process control

↓

High resource efficiency

Figure 4: About – section “Specific goals of the project”

The third category briefly describes the project's work plan. For the first time, concrete reference is made to the technical planning of the project and the individual work packages are presented. In particular, website visitors who might be interested in the Industrial Stakeholder Panel will gain an insight into the work phases of the project.

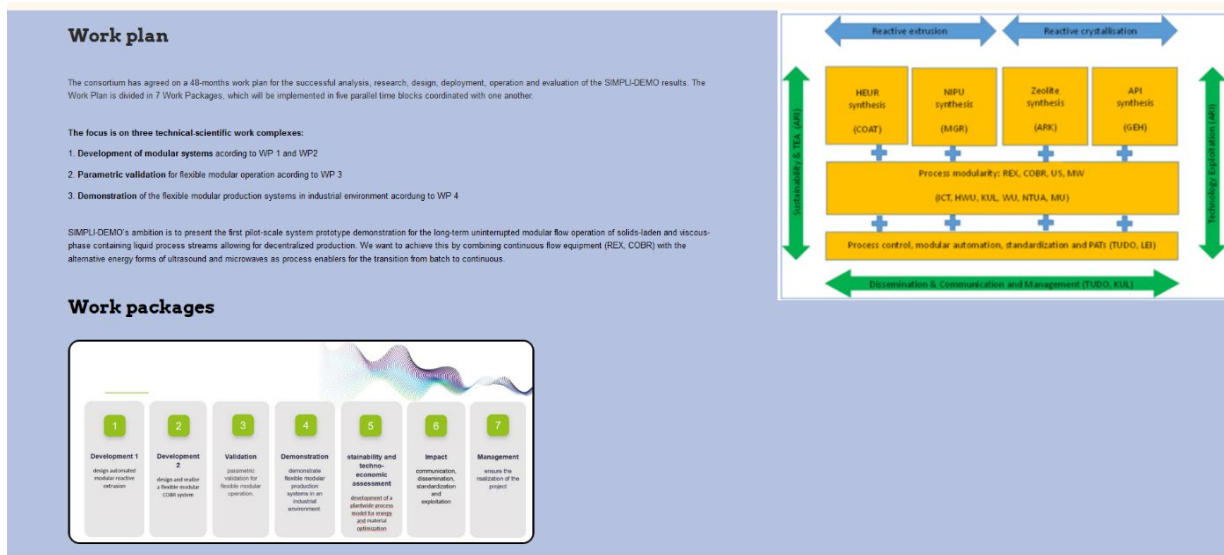


Figure 5: About – section “Work plan”

In the fourth block, the innovation approach of the technical-methodical procedure in SIMPLI-DEMO is briefly presented. The general view on scale-up, on which SIMPLI-DEMO is based, is illustrated by the information diagram.

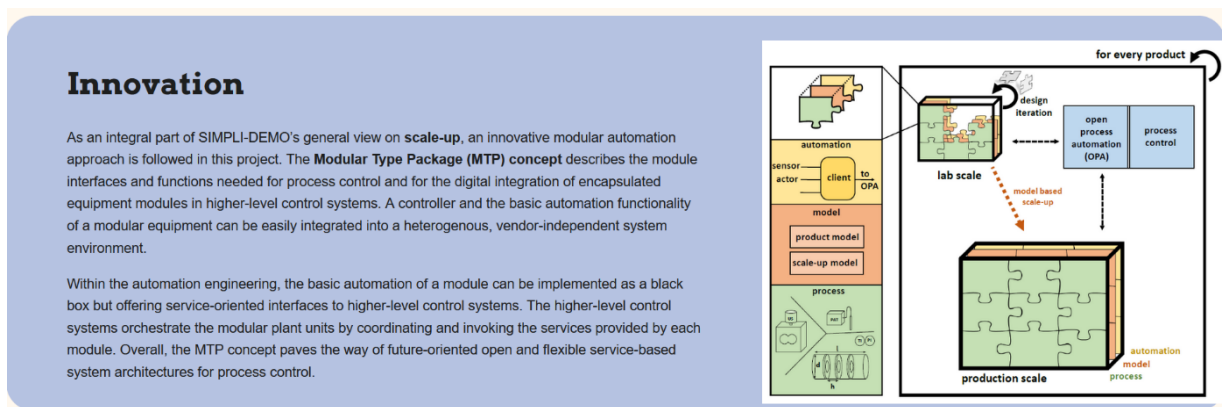


Figure 6: About – section “Innovation”

In the last point, the technical approach of the innovation project is continued by referring to the fact that in SIMPLI-DEMO the functional capability of new process plants is to be demonstrated for the first time. At the same time, the section thus refers to the diverse possibilities for launching new products on the market, which could be of interest to a large proportion of website visitors.

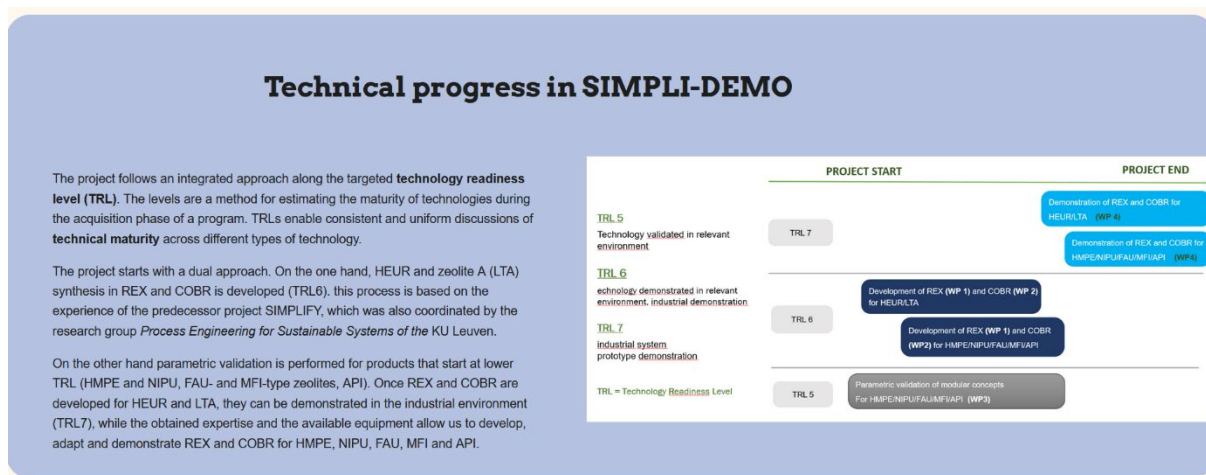


Figure 7: About – section “Technical progress in SIMPLI-DEMO”

2.2.3 Partners

The second tab in the menu structure presents the 13 consortium partners in SIMPLI-DEMO. Short overview texts describe the areas in which the institutions work, how they are networked and what contribution they make to the implementation of SIMPLI-DEMO. At the beginning of the website, there is an overview graphic that geographically locates the partners on a map of the EU countries.

Partners





KU Leuven, Belgium, is one of the top universities in Europe, ranked #42 in Times Higher Education World University ranking (2022) and #1 in Reuters' Most Innovative University in Europe (2019-2022). The research group involved in SIMPLI-DEMO is the *Process Engineering for Sustainable Systems* (ProcESS) section in the department of Chemical Engineering Department, headed by Prof. Tom Van Gerven.

ProcESS is dedicated to contribute to sustainable chemical processing by developing intensified and integrated flow sheets using continuous reactors and separators with alternative energy forms. For this project in particular the research group is focusing on process intensification by the use of ultrasound for the processing of viscous fluids and thick suspensions in extruders and oscillatory baffle flow reactors, following both an experimental and modelling approach, with the aim to achieve higher materials and energy efficiency.

Tom Van Gerven has been involved in several previous European projects within the FP7 and Horizon2020 frameworks, and he has coordinated two MSCA-ITNs and 1 Horizon2020 project (i.e. SIMPLIFY).



TU Dortmund University, Germany, is a leading German Technical University with particular strengths in chemical engineering and in the operation of chemical processes.

The Laboratory of Process Automation Systems, headed since 2020 by Prof. Sergio Lucia, focuses its research on the interface between automatic control, numerical optimization and machine learning with the goal of enabling the sustainable and efficient processes of the future. Within this project, the Laboratory of Process Automation Systems focuses on the automation, model-based control and monitoring of innovative processes to achieve a high product quality and energy efficiency.

The **Research Support Services Team** at TU Dortmund is responsible for the project management of SIMPLI-DEMO. The office supports scientists in planning and executing European research project as well as in dissemination, exploitation and innovation management. The Research Funding Unit itself actively solicits projects and grants to support its various mission areas.



National Technical University of Athens (NTUA), Greece, is among the oldest higher education institutions of Greece and the most prestigious among engineering schools. Applied Chemistry has deep historical roots in the teaching and research activities starting with the foundation of NTUA in 1836.

The main research activities of the **Laboratory of Chemical Process Engineering** at NTUA (CPEL) focus on processes for production of high quality fuels, bulk and fine chemicals as well as on environmental protection processes using process intensification principles and technologies. The researchers at the CPEL will focus on parametric studies on the effects of microwaves for the case-studies of extrusion and microparticle crystallisation (led by Prof. Georgios Stefanidis).



Fraunhofer-Gesellschaft, Germany, is the world's leading applied research organization. Fraunhofer Institute for chemical Technology ICT & Institute for structural durability and system reliability LBF will be involved in SIMPLI-DEMO research.

The *Polymer Engineering department* of the Fraunhofer institute for chemical technology (ICT) works in the whole process chain of thermoplastic processing, developing new processes and materials. With broad range of analytical techniques the department of material analytics and characterization is supporting the developments driven in SIMPLI-DEMO by obtaining a deep understanding of the produced materials.

The R&D expertise of Fraunhofer involved in SIMPLI-DEMO is primarily addressed towards products and processes in the fields of polymer technology from synthesis in reactive extrusion to material characterization, testing and quality assurance. Furthermore, intensive research activities in the field of polymer chemistry, modification, assembling and degradation of polymer systems and interaction of different components in compounding processes have been undertaken.



GE Healthcare, Norway, is the \$17.7 billion healthcare business of GE (NYSE: GE). As a leading global medical technology, pharmaceutical diagnostics and digital solutions innovator, GE Healthcare enables clinicians to make faster, more informed decisions through intelligent devices, data analytics, applications and services, supported by its Edison intelligence platform. With over 100 years of healthcare industry experience and around 48,000 employees globally, the company operates at the center of an ecosystem working toward precision health, digitizing healthcare, helping drive productivity and improve outcomes for patients, providers, health systems and researchers around the world.

GE Healthcare is the world's leading supplier of contrast media, used to support patient imaging procedures in 130+ countries globally. All stages of its contrast media manufacturing, from development of Active Pharmaceutical Ingredient (API) to finished product, are managed entirely by GE Healthcare, adhering to current Good Manufacturing Practices.

The 100-acre Lindesnes site in southern Norway, has been operating since 1974 and employs 450 people, who use multiple chemical pharmaceutical processes to convert iodine into finished API. Iohexol and iodixanol API are used in over 100 million patient doses of GE iodinated contrast media annually, equivalent to three patient procedures every second.

Continuous improvement of our chemical processes is essential. An important part of this is continuous processing. Over years we have collaborated with Professor Xiong-Wei Ni at Heriot-Watt University on continuous crystallisation, and through this we get involved in the SIMPLI-DEMO project.



Coatex, France, is one of the world's leading producers of rheological additives for aqueous formulations. The chemistry of these additives is based on low to medium molecular weight polymers. Dispersing agents, used to lower the viscosity and stabilize formulations or slurries, are usually produced by free radical or controlled radical polymerization of acrylic monomers.

Thickening agents, used to control the rheological profile of waterborne products, can be obtained either by emulsion polymerization or by polyaddition/ polycondensation. These high performance additives are used in a wide variety of applications, including mineral processing, paper industry, coating industry, home and personal care industries.



Megara Resins, Greece offers its customers advanced and diverse products and technologies for surfaces with an emphasis on environmentally friendly products such as powder coating resins, rosin dispersions, alkyd resins, water-based acrylic dispersions, and unsaturated polyester resins. Megara Resins is strengthening its foothold in important markets of the future, by investing in growth and modernization in its production sites.

Megara Resins manufactures and markets a wide range of chemicals for the paints & coatings, adhesive and construction, as well paper & packaging, printing inks, automotive, food and pharma industries. These include products for industrial and architectural coatings as well as rosin based and other synthetic resins for the paint, adhesive, paper and construction industry.

Megara Resins was established in 1961 and has initially functioned as a unit which produced gum rosin and turpentine from Greek crude gum. Over the decades, the company has developed into a performance leader in the chemical industry. In 2011 Megara Resins started the production of saturated polyester resins and additives for Powder Coatings. Three years later, in 2014, Megara Resins established company AKFA, via the acquisition of the manufacturing facilities of former Interchem/Neochimiki plant.



ARKEMA, France, is an affiliate of the Arkema Group which is a major chemical company with 16 Research centers in the world, 7 of them in France. Arkema offers a range of solutions in the science of materials structured around three growth platforms with strong synergies: adhesive solutions, advanced materials and coating solutions.

The Arkema Group is counting on a strong R&D and an Open Innovation strategy in order to develop new materials and bring them to fruition. Their work revolves around 5 R&D platforms including Lightweight materials and design, New energies and natural resources management.

Arkema is a world-renowned player in molecular sieves (zeolites) with its registered trademark Siliporite®. Arkema operates two molecular sieves production plants (in France and in Poland). The involved research center in Lacq, France, has a focus on process intensification processes, especially for zeolite synthesis, and has contributed to previous European projects within the Horizon2020 framework (i.e. COSMIC, SIMPLIFY).



AristEng S.à r.l., Luxembourg, is an engineering consulting firm (SME) which provides tailor-made and fit-for-purpose engineering services to clients of diverse background, namely industry, research institutes, universities, and project consortia.

AristEng S.à r.l. has been awarded by Luxinnovation, who is the national innovation agency of Luxembourg, as the most successful newcomer SME in Luxembourg for 2022 in the framework of Horizon Europe calls, attaining 60% success rate.

By linking research, experimental results and real production line data with process design and process synthesis principles, AristEng S.à r.l. performs detailed techno-economic evaluation and environmental impact assessment of novel processes and new products at any phase of the project development: from embryonic lab-scale concepts to mature industrial-scale facilities.

The company employs suitable simulation tools and apply solid and well-established methodologies to realize significant cost and energy-demand reduction in tandem with assessment of the overall environmental impact. Moreover, AristEng S.à r.l. has access to various experimental and lab infrastructure of their partners and scientific collaborators which can be directly used when needed. This brings versatile benefits when it comes to developing, proving and validating novel concepts of low/medium technology readiness level (TRL1-TRL4).



LeiKon, Germany supports partners in the process industry in the design and planning of investments in automation technology and production-related IT systems. The company has versatile experience in national and international projects. The focus of the company's expertise lies in different process industry sectors, such as Chemical and Petrochemical Industry and also in public domains like Water and Wastewater Treatment Plants. LeiKon GmbH is member of German and international standardizations groups like DIN/DKE, NAMUR and VDI.

LeiKon supports industrial suppliers in the implementation and commissioning of automation technology solutions and in the realization of end-to-end system integrations both along the value chain of a company and along the life cycle of a process technology plant.



MUEGGE, Germany, has become one of the leading international manufacturers and suppliers of microwave power systems for advanced industrial heating and microwave enhanced plasma applications today. The company, located 60 km south of Frankfurt/Main (Germany), is well situated to access all areas globally and within Europe.

The ISO 9001:2015 certified organization encompasses corporate and manufacturing facilities on an area of 5500 m² devoted to development, design, production, service, and support. Field offices and partner companies are in Italy, in the USA, in Japan, in Taiwan and in China, providing international field service and technical support. Since October 2020, MUEGGE is part of the investment group HQ Equita.

Having already participated in the previous European projects InnoREX (FP7) and SIMPLIFY (Horizon 2020) as technology provider for industrial microwave heating technology, MUEGGE will design, develop and set up customized industrial microwave heating solutions for targeted injection of microwave energy into automated modular reactive extrusion systems and into automated modular continuous oscillatory baffled reactor (COBR) systems for energy efficient synthesis of polymers, zeolites and active pharmaceutical ingredients (API), respectively, in SIMPLI-DEMO project.



Weber Ultrasonics AG, Germany, is a leading international technology company in the field of ultrasonic. The activities are the development, production and marketing of solutions and components for the industrial use of ultrasonic technology. The business areas focus on cleaning, welding and cutting with ultrasound and include special applications.

Since its foundation in 1998, Weber Ultrasonics has been deepening ultrasonic expertise and actively developing possibilities and processes. The company records more than 55 patents and patent applications. Together with numerous product innovations, they make a significant contribution on the way to the most efficient, precise and process-safe sound.

The product range for cleaning applications includes ultrasonic plate, submersible and rod transducers, ultrasonic flow reactors for wastewater treatment and biogas processing and more. For ultrasonic welding and cutting applications, Weber Ultrasonics develops and manufactures high-quality components like transducers, sonotrodes, and ultrasonic knives as well as customer-specific machines and devices.

The heart piece of the portfolio are ultrasonic generators, which are as all products designed and produced in Germany. The available frequencies for industrial cleaning range from 25 kHz to 1 MHz with an output power up to 3 kW and for plastic welding and cutting from 20 to 40 kHz with output powers up to 5 kW.

Figure 8: Partners

2.2.4 Case Studies

Under the tab "Case Studies" a short overview of the planned empirical studies in the project is given. In the infographic, the case studies are located in the course of the project. It also shows which end user company is involved in each study.

The case studies are listed by name in the lower section. In consultation with the respective end user companies, more detailed information on the progress and results of the case studies can be linked here during the course of the project. This may be of particular interest to technically oriented website visitors such as other end user companies, research projects or technology service providers.

CASE STUDIES

Structure

1. Phase:
For the application area of **reactive extrusion**, two case studies with different TRL are selected

2. Phase:
For the application area of **reactive crystallization**, two other case studies with different TRLs have been selected.



- 1 Polyurethane synthesis to form hydrophobically modified ethoxylated urethanes (HEUR), with COATEX as the end user 
- 2 Synthesis of non-isocyanate based polyurethane (NIPU) with MEGARA as end user 
- 3 Zeolite synthesis reaction with the end user ARKEMA 
- 4 Drug synthesis with GE HEALTHCARE as end user 

4 Case Studies

CASE STUDY 1:

HEUR REACTIVE EXTRUSION

CASE STUDY 2:

NIPU SYNTHESIS

CASE STUDY 3:

ZEOLITE MICRO-PARTICLE SYNTHESIS

CASE STUDY 4:

API PARTICLE SYNTHESIS



Figure 9: Case studies

2.2.5 Outcomes

Under the tab "Outcomes" in the menu sub-view, essential public resources are made available, which are related to the project. On the one hand, these are scientific publications and non-scientific publications (e.g. noteworthy newsletter contributions). On the other hand, these are materials that promote the project, such as project flyers, posters and other information materials.

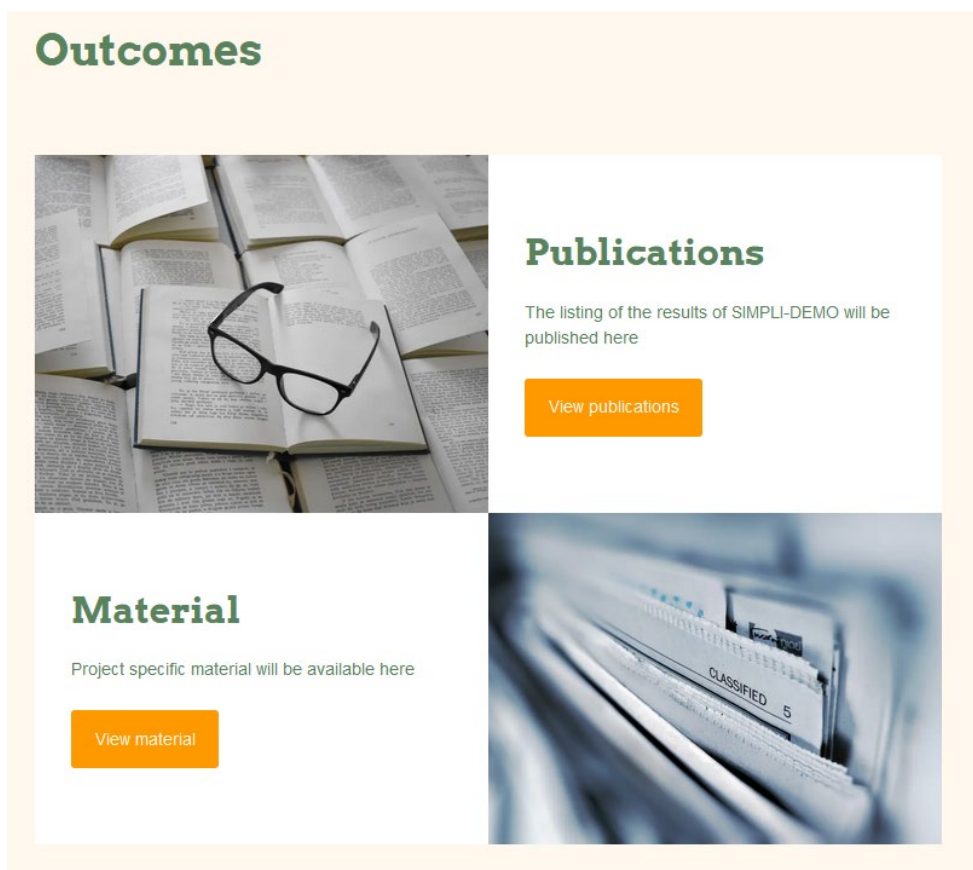


Figure 10: Outcomes

2.2.6 News & Events

Under the tab "News & Events" the website visitors are continuously informed about all news of the project. This includes the consortium meetings and other meetings that take place among the partners of the project. In addition, other events are displayed where the project is presented or discussed. These include workshops, conferences, company networks or citizen dialogs. All other communication and dissemination activities of the project will also be informed at this point.



Figure 11: News & Events

2.2.7 Contact & Newsletter

In the last traveler "Contact & Newsletter" the contact possibilities to the project are presented. The project leader Prof. Tom van Gerven is introduced. The SIMPLI-DEMO management is presented as the central contact for all public concerns. In addition, it is advertised to sign up for the biannual newsletter.

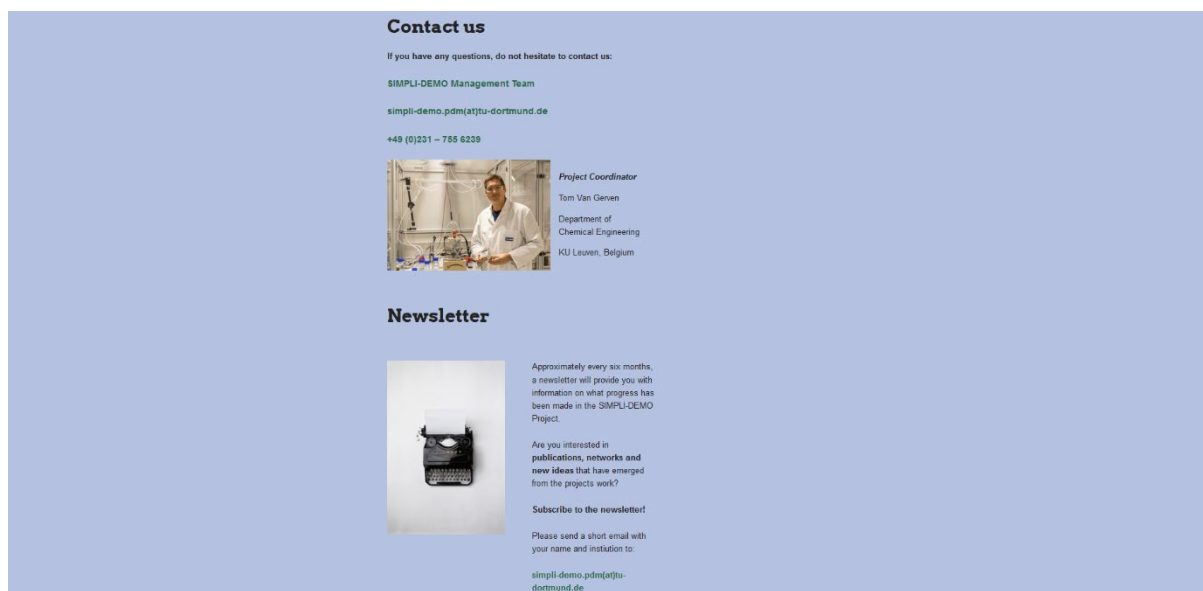


Figure 12: Contact & Newsletter

3. Setup and maintenance

The website is considered as an important dissemination channel, which needs to be updated regularly. In order to have future updates of layout and content in our own hands with a very high flexibility, it was decided to create the website ourselves. Furthermore, advanced analytics of the website visitors is desirable. Based on these requirements, WordPress (<https://wordpress.com>) was chosen as technical platform for the project website. WordPress is open source, so it is free to use. To facilitate changes of the menu structure as well as to have further design options, only one theme was added against payment.

The domain was purchased at manageable costs through the provider Strato (<https://www.strato.de/domains/>).

The website is integrated and hosted in the server environment of the partner TUDO, who has the necessary infrastructure available. The availability of the project website beyond the project lifetime is foreseen.

Logo, key-visual and other design elements were developed and provided by a designer against payment. Details will be presented in Deliverable D6.2, Communication and dissemination strategy.

4. Security concept

Backup of data is taken periodically and stored on a local server at TUDO. In case of a crash the system can be reset within a short period of time. In addition, the continuously evolving content is always deposited on the data server of the Research Funding Unit at TUDO.

An exchange of confidential data between the consortium partners is ensured via the B2DROP platform. This means that no data is stored on the website that serves as specific and work-related exchange between persons.