

Press Dossier

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WeLASER PROJECT

BACKGROUND

According to the European Parliament, our production systems should turn out enough food to feed the growing world population. In Europe, agricultural production is guaranteed using about 130 Million tonnes of synthetic herbicides every year (apart from other chemicals).

However, herbicides persist in the environment, destroy non-target plants and beneficial insects for the soil and produce health effects in animals and humans, including cancer, birth defects and disruption of the endocrine system. Moreover, farmers also realise that existing herbicides are becoming less effective due to the evolution and spread of herbicide-resistant weeds, and they would prefer to offer products free of herbicides rather than increasing the doses.

Thus, we have to adopt smarter farming methods and build more sustainable food production systems while preserving the environment and health. The EU has regulated and evaluated herbicides for commercial use, but they believe that tools should still be improved to reduce our dependence on herbicides while safeguarding competitiveness.

Today, it seems that the only weeding method that does not use herbicides is mechanical control of unwanted weeds by tillage, but it consumes fuel, is aggressive to soil and roots, and increases erosion. On the other hand, adventitious weed control approaches based on thermal effects, such as spot flames or electrical resistance heating, comply with conservation agriculture, but have high energy costs and are not common in the market. Individual irradiation of plants using a laser source allows heat treatment with moderate energy costs and with few parts subject to wear, while preserving the soil. In other words, individual irradiation allows selective treatment of individual plants, minimizing the direct effects of weed control measures on crop plants and animal life.

Consequently, and based on the EU social and environmental needs identified by the European Commission in the H2020 program call (SFS-04-2019-2020 - "Integrated health approaches and alternatives to pesticide use"), this project is developed.

WHAT IS WeLASER?

WeLASER is a precision weeding tool based on high power laser sources and autonomous mobile systems.

The main objective of WeLASER is to eradicate the use of herbicides and improve productivity and competitiveness, thus eliminating health risks and adverse environmental effects associated with the use of these materials.

For this purpose, **WeLASER is based on the application of lethal doses of energy to the meristems of unwanted weeds using a high-power laser source.**

This ambitious and innovative development has required the cooperation of a multidisciplinary intra-community group formed by 10 entities including research centers, universities, private companies and producer associations from Spain, Germany, Denmark, France, Poland, Belgium, Italy and the Netherlands under a project funded by the EU within its "Horizon 2020" program, which **has been developed over 3 years and three months with a total budget of 5,470,660 euros.**

During this period we have been working on the development of a prototype of a technological solution that, thanks to later development phases, for example in terms of improvements in the execution time of the device in the field or in the optimization of the AI image processing time and costs, would allow its commercial exploitation.

OBJECTIVES OF THE WeLASER PROJECT

1. To develop an innovative tailor-made, movable, high-power, thulium-doped fibre laser for weeding.
2. To develop an advanced artificial-intelligence (AI) detection system (image acquisition and AI-data processing) to provide the positions of the weed meristems (the plants' sensitive growth centres).
3. To build a tool (scanner) to direct the laser source onto the weed meristems in real scenarios.
4. To develop a safe autonomous vehicle, based on a proven, innovative and eco-friendly agricultural mobile platform, to carry the weeding system accurately throughout the working field.
5. To achieve a minimum impact of WeLASER precision weeding equipment on crops, environment and health.
6. To develop a smart central controller to coordinate all the systems involved in the precision weeding equipment allowing the farmers to define, execute and supervise their tasks in a reliable, robust and user-friendly way.
7. To ensure the commercial viability and exploitation of the proposed WeLASER system through the implementation of a Multi-Actor Approach.

RESULTS ACHIEVED IN THE Horizon 2020 - WeLASER PROJECT

In addition to the advances in the development of the prototype for the elimination of unwanted weeds, several concrete innovations of great importance have been achieved during this Horizon 2020 project during its 39 months of execution:

INNOVATION 1 - 2 μ m high-power fibre-laser source for weed control

This innovation comprises a high-power Thulium fiber laser operating in the 2 μ m wavelength range. A fast modulation concept allows precise energy pulses for highly efficient weed treatment. The robust design and new power supply concept enable the operation on autonomous robots. An innovative pump and cooling concept minimize the energy demand of the laser for the weeding process (by FUTONICS LASER GmbH).

INNOVATION 2 - Improved power system for autonomous robotic platforms for weeding with laser.

AGREENCULTURE is an agricultural robotics SME that is applying its know-how in robotics and integrating the AGC Box for positioning and "Safencing" as well as using several tools for farm management, such as new intelligent tools and laser weeding (by AGREENCULTURE).

INNOVATION 3 - A smart navigation manager for autonomous robots in precision agriculture

This innovation integrates control and navigation strategies both onboard the robot and in the cloud. It enables navigation throughout the whole farm, not limited exclusively to the crop field and integrates different Artificial Intelligence methodologies to identify various types of crops, including wide and narrow crops (by CSIC).

INNOVATION 4 - AI-based laser weeding implement for highly flexible weed control in variable crops and weed situations

The implement is designed for multi-row single plant treatment in crops with various row distances utilising combined laser scanners on linear stages. This design enables fast targeting and treatment of single plants. Furthermore, the laser can be applied at different angles for optimal treatment of dicot or monocot plants. The work areas of neighbouring scanners can be overlapped for patches with high weed density. The linear stages are also key to adapt the system to different row distances. The beam forming characteristics of the scanners are used to minimise the nominal ocular hazard distance (NOHD)

of the laser device which is highly important with respect to regulations on laser safety (by Laser Zentrum Hannover e.V.).

PROJECT PARTNERS

WeLASER has been possible thanks to the contribution and cooperation of 10 entities from 8 countries (Spain, Germany, Denmark, France, Poland, Belgium, Italy and the Netherlands).

Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC)
Centre for Automation and Robotics (CAR), Madrid, Spain



CSIC (Spanish National Research Council), <http://www.csic.es/>, is **the Spain's largest public research institution, and ranks third among Europe's largest research organization**. CSIC is under the responsibility of Spain's Ministry of Economy and Competitiveness through the Secretary of State for Research, Development and Innovation, and plays a key role in scientific and technological policy in Spain and worldwide.

According to its Statute (Article 4), CSIC has 4 main missions: (i) to foster multidisciplinary scientific and technological research, (ii) knowledge transfer to industry and society, (iii) education and training of scientific and technical staff and (iv) creation of Technology-Based Companies.

CSIC has 10.940 employees, including 3.764 researchers. CSIC has 123 Institutes spread across the country and covering different areas of Science and Technology. 70 of them are fully-owned institutes and 53 are Joint Research Units in partnership with other Spanish universities or research institutions. CSIC has also a delegation in Brussels.

CSIC is a major player in the development of the European research area and therefore a significant contributor to the European integration process. CSIC signed 726 actions (including 70 coordinated by CSIC) within the 7th Framework Programme with a total contribution of over €264 million, and 512 projects with a total EU financial contribution of €217 million through the H2020 programme. **According to E-CORDA, CSIC is listed as number one in Spain and 4th throughout Europe in terms of the number of projects within the research organisations.**

The Centre for Automation and Robotics of CSIC (CSIC-CAR), <http://www.car.upm-csic.es/>, is the center responsible for the WeLASER project. The CSIC-CAR group has participated in many EC project (see below) and has managed four research Projects at European programmes as the coordinator: INCO-Copernicus Project 960054, ESPRIT 02/76100, GRD1-1999-11153 and RHEA FP7 N. 245986.

The CSIC-CAR owns some facilities that will be essential for the project development such as (i) an electric/electronic workshop, with equipment for electronic cards design and manufacturing; (ii) a mechanical workshop, with equipment for both manufacturing and mounting robotic prototypes; (iii) a large laboratory for the integration of heavy equipment and (iv) some fields for growing crops

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Futonics Laser GmbH (FUT)
Katlenburg-Lindau, Germany



Futonics Laser GmbH (www.futonics.de) is a small startup company in the middle of Germany with the headquarter in Katlenburg-Lindau and a branch office including the research and development department in Göttingen.



Co-funded by the Horizon 2020 programme
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Founded in 2018 by Dr. Peter Fuhrberg, it is a spin-off of Lisa laser products OHG with its main focus on **developing high-power infrared laser sources for industrial and scientific applications.**

Futonics and its employees have great experience in the development of infrared laser systems and can look back on over 10 years of experience and many national and international research projects and collaborations. Based on these research projects different new products were introduced to the market.

Futonics offers 2.0 μm fiber laser systems with output powers from 10 Watts to 500 Watts that can deliver single-mode beam quality over the whole power range. The systems utilize a highly robust design and can be built with selected wavelengths in the range from 1930 nm to 2050 nm.

Futonics also offers optics optimized in the mid-IR spectrum like collimators, f-theta lenses for scanner systems, processing heads and delivery fibers.

In 2020, Futonics took 3rd place out of 43 applicants for the Innovation Award of the District of Göttingen.

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Laser Zentrum Hannover (LZH)
Hannover, Germany



Since 1986, the Laser Zentrum Hannover e.V. (LZH) **has been committed to advancing laser technology. Supported by the Lower Saxony Ministry for Economics, Labor and Transport**, the LZH has been devoted to the selfless promotion of applied research in the field of laser technology. The LZH is a **private non-profit research and development institution**, having the legal status of a registered association.

Research, development, consulting, training and education as well as the promotion of young talents in the fields of photonics and laser technology are the main tasks of the LZH. Work in the endorsed research projects always aims at the current and future demands of the business.

For industrial projects, the focus of the work of the LZH is on direct customer benefits. The activities of the LZH in WeLASER will be carried out by two groups: Food & Farming Group (FAF) in the Biomedical Optics Department and the Safety Technology Group (SHT) in the Materials and Processes Department.

The FAF group aims at transferring optical technologies to application in the agriculture and food industry, building on the employees' expertise from imaging and spectroscopy to laser-tissue and laser-plant interaction. Relevant topics include laser disinfection of food (poultry), laser labelling (plants, fruit, carcasses), as well as weed and pest control in agricultural production (laser weeding and treatment of herbivorous insects).

Apart from a broad knowledge in the field of laser process development, **the scientific employees of the SHT Group can rely on long-term experience and extensive know-how in the field of laser safety.**

Important areas of their work are the evaluation of exposure with respect to specular and diffusely reflected laser radiation, the performance of risk analyses and the development of laser safety concepts for different laser material processing tasks.

In the case of WeLASER, the focus has been on the investigation of safety aspects in the course of mobile and hand-held laser processing methods and tools. An important example in this context is the actual cooperative national project "LaserRescue", in which a device for rescue in complex accident scenarios is developed.

A main part of the project work is the evaluation of risks connected with the high-power laser radiation used and the development and integration of concepts and components to guarantee the employees' occupational safety and health.

A former project of the SHT Group in which technical laser safety was an important aspect to be considered and investigated is the laser equipment assessment subproject MOBILLAS as a part of the EU project LASHARE (EU FP7-ICT project “Laser equipment ASsessment for High impAct innovation in the manufactuRing European industry”, ref. no. 609046). In the former EU project “PROSYS-Laser”, the employees of the SHT Group dealt with the analysis and development of laser-protective clothing and curtains for the use with hand-held laser processing devices. Moreover, a thorough investigation of applicable technical safety measures for the use of hand-held laser processing devices was performed in the course of a further national project funded by the Federal Institute for Occupational Safety and Health (BAuA, project F 2158).

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University of Copenhagen (UCPH)
Copenhagen, Denmark



The University of Copenhagen is the oldest and largest university in Denmark, founding in 1479. It consists of six faculties, 35 departments and more than 200 research centres. There are four campuses in Copenhagen, ten museums and ten research gardens. It has more than 38,000 students. There are 9348 employees of whom 4856 are researchers who produced 12,982 research publications in 2017. The university had in 2018 a total income of 8,902,775,000 DKK and ordinary operation expenses of 8,636,386,000 DKK. In 2018, UCPH was involved in 5000 grant-funded research projects, of which 1887 received funding from Danish public funds, 2,199 from Danish private funds, 461 from EU funds and 453 from foreign funds.

Internationally, the University is highly competitive and is the highest-ranking university in Denmark, and often the highest-ranking University in the Nordic Region, **and number 6 in Europe according to the ARWU – Shanghai index (2019)**. Internationally, the University ranks at a level that corresponds to a position among the top 1 percent of the World’s universities. **It has received nine Nobel prizes.**

The Department of Plant and Environmental Sciences (PLEN) conducts **pioneering research that creates knowledge about basic biological, chemical** and physical processes and brings into play academic knowledge in conventional and new innovative biological production. **The Plant Protection Research Group has a strong focus on using new technologies to ensure high crop yields and at the same time reducing pesticide use and unwanted side-effects of plant protection.**

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AGREENCULTURE (AGC)
Toulouse, France



AgreenCulture is a startup founded in 2016 based on Navontime technology. This technology is a cost efficient and reliable GNSS RTK. All founders brought their aeronautical skills to farming robot including safety management.

AgreenCulture is now a robot manufacturer specialized in systems design, reliable positioning, safe guidance for smart farming. The company is working in developing in partnership several dedicated robots for vineyard, orchards or corn with big expert companies like Pellenc, Kuhn or Syngenta. The company employees 25 people. Most of the team are dedicated to development.

AgreenCulture has been awarded “Robot of the year 2018” by Al.ven with Centéol robot. In 2018 the company received an award by ESA for its safe and accurate GNSS system.

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Spanish coordinator of farmers and livestock breeders (COAG)
Madrid, Spain



COAG (Spanish coordinator of farmers and livestock breeders) www.coag.org as the **main representative entity of the farming sector in Spain**, is constituted by 100,000 professional farmers and has 200 offices throughout the territory of Spain, plus a representation permanent office in Brussels. This structure allows us to satisfy the demands and needs for information, advice and knowledge of those interested in participating in different activities.

COAG is a **non-profit-making organisation**, so all its activities are aimed to defend the farmer's interests. COAG is a **state-level entity incorporating professional organizations** (19 representing all Spanish regions) of farmer unions, livestock farmers as or foresters, owners of farms or agricultural businesses.

COAG serves as a link between their members and the scientist and research world and has a fundamental role in the exchange (not only transfer) of agricultural knowledge from and to farmers. For that purpose COAG uses all its resources and available instruments, including mainly the technical-scientific qualification of their staff and the management capacity of the continuous training that are a priority in the organization activity.

COAG is member of the two main European farmers organisations COPA-COGECA (www.copa-cogeca.eu) and European Coordination Via Campesina (ECVC) www.eurovia.org. COAG coordinates the ECVC Innovation Area and represents this organization in the Permanent Subgroup on Innovation for agricultural productivity and sustainability of the European Network for Rural Development, which helps to define the activities of the EIP AGRI.

COAG is also a perfect organization to disseminate results of a project. For instance, COAG, through its territorial unions, disposes a strong editorial group that reaches the Spanish collective of farmers and ranchers. We have active social networks too (@COAGInnova – 2.000 followers, @La_COAG – 11.500 followers). But also, COAG can collect farmers' needs as an input for a project or activity.

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University of Bologna (UNIBO)
Interdepartmental Center for AgriFood Industrial Research, Bologna, Italy



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Since its origins in 1088, the University of Bologna has been student-centered hosting prominent figures from science and the arts. Based in five campuses (Bologna, Cesena, Forlì, Ravenna, Rimini), with a branch in Buenos Aires, it offers a teaching catalogue diversified and tailored to the needs of present-day society: over 200 degree programmes among its 32 Departments and 11 Schools are offered to over 81,000 students, 5,000 graduates are enrolled in PhDs.

As a comprehensive research university, the University of Bologna invests in the multidisciplinary cross-cultural approach and in the inseparable connection between research and teaching. One of the most active universities leading and participating in European research and academic cooperation projects, UNIBO has formed knowledge alliances with industries and public/private organizations and is a hub of international networks. Beyond its close European links, it enjoys multiple connections with America, Africa, Asia and Australia.

Research and Innovation is a priority of the University's mission. With regard to Innovation, UNIBO filed 86 new patent applications in 2017, of which 25 are new registrations, thereby giving rise to an active patent portfolio of **over 370 patents related to more than 140 inventions. It also has an active portfolio of more than 20 patented plant varieties, 80% of which are increased in value through active licenses with geographic coverage in countries in different parts of the world.** UNIBO set up or accredited 27 spin-off companies up to 2017 and can also count Almacube, as business incubator that managed 15 incubated companies in 2017.

With regard to the capability of attracting funding for research and innovation, UNIBO is very active both at National and European level in all research areas. Activities related to competitive funding programmes are supported by the Research Division, with over 10 years of experience and about 50 people assisting the research groups in the whole project lifecycle. A Research Development Office deals with the pre-award phase and the UNIBO strategic positioning at local, national and international level, through integrated networking and lobby activities in each specific research area. The Programmes & Projects Office supports the UNIBO researchers from the projects' implementation phase with technical, legal, financial and administrative expertise. These Offices strictly cooperate among each other and work in direct connection with the Knowledge Transfer Office, which is responsible for the Innovation Management, the IP protection and exploitation, and the take up and commercialization of the project results.

Thanks to its scientific excellence and a central Project Management support working closely, UNIBO has gained a considerable experience in International and European research projects and successfully participated in FP7 with 274 projects funded in 2007-2013 (58 as coordinator) and 87,8M€ of funding.

In Horizon 2020, UNIBO is so far involved in 238 funded projects (59 as coordinator) with more than 97,6M€ of funding. UNIBO is also partner of the EIT Knowledge & Innovation Communities and many of the most important EU initiatives related to the Horizon 2020 framework program (i.e. ETPs, EIPs, JPIs, etc.).

Two research groups from UNIBO will participate in WeLASER, from the Department of Agricultural and Food Sciences (DiSTAL), and from the Department of Computer Science and Engineering (DISI).

The DiSTAL recognized in 2019 as an Italian Departments of Excellence, collects scientists from almost all branch of agriculture. It will be contribute to the project by researchers working for more than 30 years on soil science, agro-meteorology and eco-physiology, recently focusing on sensors and recording platforms designed to collect information on soil-plant-atmosphere system (smart-farming) to be integrated in Decision Support Systems, Precision Farming and Big-Data-based Knowledge Development **to increase farming system sustainability.**

To the scope DiSTAL already interact with DISI, that participates with the Business Intelligence Group that has a 20 year experience on data management, data analysis and machine learning. In the last 10 years DISI researches focused on Big data and IoT. Research groups are following both theoretical and application topics, participating to both European and Italian projects and collaborate in building a big data platform for precision agriculture that is capable of collecting and analyzing geo-referenced data from on the field sensors and satellite images.

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Instytut Ekologii Terenów Uprzemysłowych (IETU)
Katowice, Poland



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Instytut Ekologii Terenów Uprzemysłowionych (The Institute for Ecology of Industrial Areas) (IETU), Katowice, Poland was established in 1972 as branch of the Institute of Environmental Protection in Warsaw, independent body since 1992 is an R&D unit acting under the Ministry of Environment.

IETU has a wide experience in development of environmental policy, strategic management and policy tools for sustainable development at different levels for the needs of national and regional authorities and businesses. Our key areas of expertise include waste management, resource efficiency, transformations of urban environment, diagnosing and prognosis of the state of environment, microbiology, phytoremediation.

Since 2005 IETU is involved in activities aimed at bridging the gap between research and businesses in support of ecoinnovation coordinating Polish Platform of Ecoinnovation, Scientific Network on Environmental Technologies (ENVITECH-Net) and playing an active role in implementing ETAP/ECOAP in Poland and the EU Pilot Programme of Environmental Technologies Verification in Poland, Europe and globally.

At regional level, we cooperate closely with Silesian Cluster of Environmental Technologies, Silesian Cluster of Waste Management and Regional Network of Municipal Waste Consultants. These activities allowed us to build an extensive network of stakeholders.

Recent area of IETU activity is focused on verifying the performance of ecoinnovative technologies and assessing their environmental added value. IETU has been actively co-operating with R&D units, academia and governmental bodies at home and internationally. IETU staff consists of 72 members including 49 scientists which are experts from disciplines relevant to environmental management, waste management, spatial planning, environmental policy and instruments. IETU has a long track record-term experience in EU projects including participation in consortia of over 50 EU projects which proves our competence in collaborating in international consortia.

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Universiteit Gent (UGENT) Gent, Belgium



Ghent University is a top 100 university and one of the major Belgian universities counting over 44,000 students and 15,000 employees.

Located in Flanders, the Dutch-speaking part of Belgium and the cultural and economic heart of Europe, Ghent University is an active partner in national and international educational, scientific and industrial cooperation. With a view to cooperation in research and scientific service, numerous research groups, centres and institutes have been founded over the years. Several of them are renowned worldwide, in various scientific disciplines such as biotechnology, aquaculture, microelectronics, history, etc. Within the Agricultural Economics department at the faculty of Bioscience engineering the research activities of the Agri-food marketing and chain management division concentrate on the agri-business sector (agriculture, horticulture, fisheries, food processing and distribution), both on the domestic and foreign markets (EU, Central and Eastern Europe, south-east Asia and Africa). More specifically, the following research topics are well developed within the Agro-Marketing division:

- Consumer attitudes and behaviour
- Agri-business competitiveness and management
- Socio-economic analysis (e.g. changes in public policy, ethics)
- Policy evaluation
- Waste management: sustainability of by-products
- Price formation and analysis
- Innovation management

- Chain management in the agri-business sector
- Quality management in food and agriculture
- Feasibility and investment studies (cost-benefit analysis)

Within Ghent University's supporting framework for collaboration with industry, the business development center Food2Know focuses on innovation in feed, food and health. The group brings together different scientific experts throughout the food value chain and has large expertise on IP management, dissemination and valorization activities in national as well as international projects. Moreover, the project managers of Food2Know are experienced in the scientific as well as administrative coordination of large projects. The group can build on a strong network and good relations with feed and food-related sector organizations, industrial partners and governmental organizations on regional as well as EU and global level.

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Van Den Borne Projecten BV (VDBP)
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Van Den Borne Projecten BV is the innovation department of Van Den Borne Aardappelen, a family farm in Reusel, tilling in the Netherlands and Belgium.

Van Den Borne Borne is an active member of Zuidelijke Land en Tuinbouw Organisatie, (ZLTO), the Southern Netherlands organisation of 13.000 farmers with 9.000 farms. ZLTO is one of the three organizations that work in the federation LTO Nederland (50.000 Dutch Farmers) and a member of Copa Cogeca, the European farmer organization.

Jacob Van Den Borne makes his company data available through his website VanDenBorneAardappelen.com, flies drones over his fields, uses satellite data and is researching, analysing and visualizing soil scans and yield data. After more than 10 years experimenting and applying precision farming at scale Jacob co-founded on his property the Practice Centre for Precision Agriculture, an official Smart Industry Fieldlab, with the goal to help suppliers and colleague farmers discover benefits in using technology and data to better understand nature and get more sustainable yields. Van Den Borne is an innovator in different agricultural sectors (arable, feed production, robotization) on different themes (Precision Agriculture, Data-Driven Farming, sustainable fertilization, irrigation, renewable energy, sustainable plant protection techniques, new products and innovative commercialization).

With ZLTO, Wageningen Research, Technical University of Eindhoven, HAS University of Applied Agricultural Science, Technical University Delft, vocational schools, Van Den Borne cooperates in Practice Centre for precision Agriculture, where demonstration research is organized and 160 farmers in Innovation Groups are challenged to innovate. He is the founder of [CloudFarm](#) for precision data is now used by Fendt dealer Mechanical Group as a high-end farm management system. Furthermore, the 180 fields farm totalling 500 ha managed by 8 people has its own fully live operational intelligence dashboards.

Apart from the Farm and Practice Center, Jacob van den Borne owns [LoonwerkGPS](#), which provides soil health maps based on EM conductivity (Dual EM) and he is an initiator of [Kempenglas](#): glass fiber cooperative for 1000s of households in the region between Eindhoven and Tilburg.

VDBP will bring the expertise gained in the EIP-AGRI Focus Group [Precision Farming](#) and Operational Group [Controlled Traffic Farming](#).

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