

Workshop-Report:

Research Infrastructure at the academia-industry interface:

The role of European networks for Field Trial Sites and Pilot Plants

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Summary

On 18-19 February, Science Europe (SE) Working Group on Research Infrastructures, the Scientific Committees for Engineering (ENGITECH) and for Life, Environmental and Geo Sciences (LEGS), organised a workshop as a pilot activity to explore the role of networking for Research Infrastructures (RIs) which operates at the academia - industry interface.

The workshop focused on two types of RIs, the 'field trial sites' (FTS) and the 'engineering pilot plants' (PP). Although looking dissimilar, both types constitute an intermediate step between the laboratory or glass-house scale and industrial production; both need to actively engage with stakeholders outside academia.

Managers and operators of both facility types identified similar potential benefits to networking, including but not limited to: exchanging scientific and technical knowledge, reaching critical mass, creating education and training opportunities, addressing data ownership and confidentiality issues.

Specificities of each facility type were also discussed. Different models were profiled: the 'one-stop-shop' model whereby a FTS network can be an authoritative information source on a broad range of questions regarding crop production for authorities or farmers (in addition to scientists), or the focused single purpose pilot plant delivering one specific type of product. With regards to FTS, the establishment of a pan-European network of field research sites for controlled experimentation towards sustainable agriculture systems, based on existing infrastructures, was discussed; the challenges ahead include the urgency to take into account the effects of climate change and to ensure food security for a growing global population. These specificities would influence the way the objectives and membership of any potential network would be defined.

The workshop led to concrete follow-up activities. For instance, Hartmut Stützel, Vice Chair of the DFG Senate Commission on Agroecosystem Research and Dirk Inze, LEGS Committee Chair, agreed to collaborate on a position paper as basis for further in depth discussion on the needs for a European FTS network engaging with a broader range of potential participants.

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Introduction

Science Europe (SE) is an association of European Research Funding Organisations (RFO) and Research Performing Organisations (RPO), based in Brussels. Science Europe serves as a platform to promote the collective interests of its Member Organisations (MOs) and explore their role in the European research system. The research community is given a strong voice through six disciplinary scientific committees.

The SE Working Group on Research Infrastructures (WG RIs), in liaison with the Scientific Committees for Engineering (ENGITECH) and Life, Environmental and Geo Sciences (LEGS), organised a workshop as a pilot activity to explore the networking of two sectors of research infrastructures (RIs) that seemed so far potentially disconnected, at least on the European level.

The two selected sectors of RIs were 'distributed field trial sites' and 'engineering pilot plants'. The two sectors might look rather dissimilar. However, both constitute an intermediate step between the laboratory or glass-house scale and industrial production. As such, both sectors need to take into account stakeholders outside academia.

Creating infrastructure networks may be helpful for research collaboration in the applied spectrum of research, and with direct benefits for European competitiveness. In such context, the interfacing of academic and non-academic actors when developing networks of RIs in these sectors is crucial.

A workshop on the networking of Pilot Plants and Field Trial Sites

The workshop convened funders, managers and operators of facilities to investigate the following: Can research infrastructures at the interface between academia and industry be used more efficiently and effectively? What are the barriers? What can be improved? How can the networking of these research infrastructures help?

The creation of a European RI network can trigger discussions on both generic and topical aspects. Hence the workshop was structured along parallel sessions to discuss specificities of both selected sectors and joint sessions to foster the cross-fertilisation of ideas for initiating transnational networks.

The programme of the workshop and the list of participants can be found in the annex.

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Field Trial Sites (FTS)

National views and experiences

LEGS Committee Chair Dirk Inze emphasized in the opening of the session that networking on the European level can bring benefits to both the national sites and the scientific field as a whole. Hartmut Stützel, Vice Chair of the DFG Senate Commission on Agroecosystem Research, summarized in his introductory talk the current state of FTS as research infrastructures on the example of Germany.

Although FTS are essential infrastructure for research in agronomy, plant breeding, crop protection and agro-ecology, their role and importance is often not recognized. As a consequence, FTS are often under-equipped, under-financed, not up to date and sometimes closed down based only on the cost factor. The fragmentation of institutions for agricultural research impedes the adoption of common standards and establishment of best practice models for FTS. Each FTS works with its individual set of equipment under the conditions dictated by the given site. Other research sectors, e.g. marine research, that depend on major and expensive research infrastructure such as research vessels seem better recognized in their needs. Obviously, the federal ministry in Germany feels responsible for addressing this need. So what could be the equivalent of the research vessels in the agricultural sector?

Upcoming research themes in the areas of agro-ecological research, such as crop productivity, climate change, nutrient fluxes, resource efficiency, stress mitigation and resilient production systems must consider environmental variation, gradients of environmental parameters and agronomic management. Adequate research infrastructure is required for effective research.

But agricultural research is not only a scientific endeavour and relevant for agricultural industry. It is also a mission for identifying perspectives for fundamental research for sustainable and resource-efficient yield improvement. As such it is also of societal importance and addresses grand challenges.

The goals of a FTS network could be:

- Improved economic and administrative security/stability
- Co-ordinated development of individual FTS by
 - Optimized allocation of resources
 - Specialization
- Exchange of services: conduct each experiment at the most suitable location
- Improved services to the research community through
 - Up-to-date technical equipment
 - Specialization

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- Common methodological standards and quality assurance
- Gradients of climatic and soil factors
- Enhanced collaboration and interdisciplinarity

The research stations could also be linked with the official monitoring stations. The former are few, but offer agronomic or genetic variation. The latter are many and have long-term data sets.

As in many other sectors, availability of and access to data is important. Data repositories should offer open access for the research community and should be organized in a way that allows to cite the data one uses, thereby demonstrating the usefulness of the data.

For Germany a survey in 2012 among 30 research station revealed:

- a big investment backlog,
- widespread interest in research on nutrient fluxes and effects of climate change,
- great willingness to collaborate, but also concerns about loss of autonomy.

Networking should be organized efficiently with short decision making processes and clear regulations of responsibilities for use of data and regarding publication of results. On the financial side cost sharing of users and fair allocation of financial resources for investments are important. Regional networks can be useful.

The challenges for long term field experiments were demonstrated by Heide Spiegel on the example of Austria. Treatment, management and technologies change over time and interpretation of time series becomes more and more difficult.

Nevertheless, long-term field experiments are indispensable to quantify the effects of changes in agricultural management (e.g. tillage, organic and mineral fertilisation, management of crop residues,..) on soil and crop parameters such as soil quality and soil fertility. They give evidence about the time scales of changes, such as early detection of tillage-induced changes of microbial parameters or medium to long-term changes in soil organic matter and nutrient dynamics. Long-term field experiments are also needed to develop and test new methods of analysis or observe changes in biogeochemical cycles.

However, not all long-term field experiments can be carried on forever and it is a difficult and open question, by what criteria to identify those experiments that should have highest priority for continuation.

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In Austria an Experimental Farms Network (EFNet) was recently founded for exchanging experience and experts. A number of Austrian sites are also part of the LTER (Long Term Ecosystem/Ecological Research) network.

The complementarity of greenhouse and FTS was highlighted by Hilde Nelissen from Belgium. The consequences of well-defined settings in the greenhouse can be observed by automated phenotyping and compared to information from next generation sequencing. On the field no “typical” growth conditions exist. Plant density can be variable. A dedicated “from pot to plot” approach is needed to bridge this gap. A new ESFRI initiative for phenotyping, called EMPHASIS (European Multi-environment Plant PHenotyping And Simulation InfraStructure), is aiming at this issue.

Field trials need different climatological conditions (spread over Europe), easy access and should be possible for both non-GM and GM crops (GM: genetically modified). A network of partners from different European regions could offer advanced field phenotyping. Challenges are desirable uniformity of data/information from diverse partners and, of course, the large investments that are needed.

In an ideal world, scientists would have easy access to dedicated field sites over different climatological regions, equipped with top-notch phenotyping tools that allow for meta-analysis.

The importance of FTS and the research carried out there also for local authorities was emphasised by Carlo Grignani. In Italy the project IC-FAR, funded by the Italian ministry (MIUR) has been a step towards an FTS network and serves as preparation for a participation to the ESFRI project ANAEE. While investment costs are high, as expected, financial analyses in the frame of this network showed that also costs for personnel constitute a major fraction of total costs.

Collaboration with farmer associations is difficult in Italy, but policy makers are quite interested in the results as basis for designing or reporting local policies. Barriers to the networking come primarily from bureaucracy and the fragmentation of universities and institutional budgets.

The potential benefits of networking include:

- Create critical mass for discussions with funding bodies
- Constitute critical mass to fight against non-necessary administrative rules
- Convergence of research objectives
- Better understanding of influencing factors by comparison (‘It depends...’ on what?). Understand variability as a friend and not as an obstacle

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- Evolving and more ambitious research questions (e.g. climate change)
- Fostering mobility of researchers
- Provide a basis to create teaching networks (in particular at master and PhD level)
- One-stop shop for stakeholders (scientists, policy makers, farmers/farmers associations, students, lifelong learning programs...) when a new question is pending

In conclusion: A distributed RI of FTSs is more than the sum of single FTSs.

The institute of Soil Science and Plant Cultivation in Putawy, Poland, was presented by Wiesław Oleszek. The institute has a strong relation to the ministry of agriculture and several large productive farms are under the control of this State institute. The FTS are either productive or used in research projects and are financially self-sustaining. The centralized organisation of individual FTS in Poland allows for a systematic approach, and a plethora of data has been acquired under defined conditions. Examples for recent projects are:

- Influence of production system on winter wheat weed infestation and soil seed bank
- Biodiversity and activity of microorganisms in carbon and nitrogen changes in soil under ecological, conventional, and integrated management system
- The use of the new diagnostic techniques for detection of pathogenic fungi of winter wheat cultivated in different production systems
- Evaluation of nitrogen utilization and losses in different crop production systems
- Evaluation of selected winter wheat varieties for cultivation in organic farming
- The evaluation of competitive ability of some winter wheat varieties cultivated in organic crop production system to weeds

In Sweden forestry is much more important than agriculture, but sometimes agricultural research can make use of what has been archived in the forestry sector, for example the Swedish forest field research network. The (existing) ICOS network could also be an example for an FTS network.

The Swedish University of Agricultural Sciences has many sites. To 80% it has the purpose of a university, but with 20% also that of a State institute. So besides the scientific tasks there are also societal tasks, e.g. contact to farmers. Farmers in Sweden are typically very open to new ideas and new ways of agricultural production.

The Swedish Research Council had issued a call for research infrastructure proposals two years ago and FTS have received some funding from that – a critical prerequisite for some FTS. However, funding for data analysis is scarce. Data ownership, different data formats and variable analytic methods turn out as major barriers to networking.

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In Switzerland vandalism on FTSs lead to the creation of a Protected Site with a dedicated Governmental mandate and (financial) support. The mandate includes the task of communicating with citizens and farmers and providing a basis for an objective debate about genetically modified plants. Experience so far tells that research is a much more accepted argument in favour of GM field trials compared to other arguments.

At Rothamsted Research, the oldest agricultural research station in the world, very good experience was made with early and pro-active information for the public. Jonathan Napier reported, how the FTS of Rothamsted try to approach the phenotyping challenge by high-throughput and automated analysis. Autonomous UAVs (unmanned aerial vehicles) or ground based sensor platforms with 24/7 operation are developed. Monitoring root performance has been identified as new and important task.

Summary

Common research rationale for a European FTS research infrastructure network:

Sustainability of different farming systems and technologies needs to be tested under a range of environmental conditions (=> network of field trial sites and experimental facilities); suitable sustainability indicators need to be selected. Field trials are needed, as they are the first step to put laboratory and greenhouse research to the real-world test.

Can we identify new plant indicators for soil functions and functioning (link between plant phenotyping and soil science)? Benefits of agricultural/plant/environmental sciences need to be better communicated to society to receive the required support.

The primary **needs of Field Trial Sites** were identified as

- Long-term financial support (ideally with governmental mandate)
- Ideally: Location at a public research institute
- Strong support in communication
- Data management and rules for data sharing

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Networking can help to

- achieve critical mass: scientifically and administratively
- provide the basis for meta-analyses
- define common & ambitious research objectives (e.g. climate change)
- better understand influencing factors
- set up standards for equipment, measurements, administration, data policy
- foster mobility of researchers

Members of such a network would be

- academic and research entities that own FTSS
- modellers
- farmers associations
- industry
- policy makers interested in results to design/report local policies

As open question remained, if field trial sites should be linked with agricultural/plant experimental facilities.

Barriers to networking are

- fragmentation of research institutions and institutional budgets
- bureaucracy
- different measurement protocols
- different data formats
- data ownership

Next Steps

Science Europe LEGS committee and the DFG Senate Commission on Agroecosystem Research decided to work on a position paper on the need for a European network of FTS-RI.

It is important to intensify and deepen the discussion with a broader range of potential participants of such a network.

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Pilot Plants (PP)

The Pilot Plants session showed clearly that the collaboration with industry is a central aspect of these kind of research infrastructure. Different examples had in common that the successful pilot plant facilities are used by both academia and industry. Unsurprisingly, confidentiality and intellectual property (IP) are important issues that must be understood and respected by all partners, who might be collaborators and competitors to varying degrees.

Open innovation multi-purpose pilot plants – often as public-private partnerships (PPP) – offer unique services, typically as contract research or small-scale production, that the individual company would normally not be able to afford. Focused pilot plants, on the other hand, are specialized in a given area, but still allow for thorough investigation / testing of the respective production or refinement process. Pilot plants inside companies are considered to be more often than not one-trick ponies. This considerations support the view that pilot plant facilities as jointly usable and used research infrastructures are both efficient and effective at the academia-industry interface.

Pilot plants share typical challenges of research infrastructures, such as recruiting and training skilled personnel, demonstrating economic and societal impact, and, last not least, securing continuous funding.

A network of PP facilities can help to exchange scientific and technical knowledge, it allows sharing of facilities and equipment thus filling gaps and increasing critical mass. Additionally, a network might offer a suitable platform for

- increasing visibility, both for the network and for each facility individually,
- demonstrating value to the corporate users,
- demonstrating impact to the (public) funding bodies,
- developing business awareness,
- providing capacity to negotiate costs and IP with users, and
- representing the interests of pilot plants on the national and European level.

The potential members of a PP network will depend on the industry field and the objectives of the network. In addition to facility managers, researchers and corporate users they might include technology transfer offices, regulatory bodies and policy owners. For the users there could be a tension between considering them as clients or as members of the network. The network should be open and must not appear as a closed club.

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Initial barriers to networking are confidentiality regarding projects and users, competition instead of collaboration, lack of awareness of and interaction with other pilot plants and research infrastructures and, currently, the absence of suitable fora.

A useful next step would be creating an exchange platform for some first joint actions.

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Joint discussion of European networking

Two European initiatives were presented as examples for European networking.

The ESFRI project ANAEE (ANALysis and Experimentation on Ecosystems) is currently in its preparatory phase. The coordinator Abad Chabbi presented the vision and current status of ANAEE. As most other distributed research infrastructures of the ESFRI roadmap, also ANAEE struggles with a number of challenges regarding broad consultation with and participation of national research communities and further stakeholders. Governance and financial models are often more difficult to establish for distributed structures as compared to single research vessels, for instance, or single sited infrastructures. On the political as well as administrative level more experience is available for major single pieces of RI as compared to the somewhat newer distributed models.

While ANAEE clearly touches several aspects of a potential FTS network, it did not yet become clear in the discussion, if ANAEE could include an FTS network as part of the intended structure.

BRISK (Biofuels Research Infrastructure for Sharing Knowledge) is an EC funded integrating activity of the 7th framework that brings together a number of pilot plants that offer access for research projects to the individual PP sites. Andrew Martin, project manager of BRISK, reported on experience with offering and granting transnational access. A database of available facilities is an obvious prerequisite. Misconceptions about RI networks in general and a lack of awareness of the possibilities offered by BRISK have led to a delay of requests for access, which is now strongly increasing.

A specific challenge in the FP-7 integrating activities is the size of the consortium. Too small consortia lack critical mass (at least according to the EC). Too large consortia reduce the pool of outside users prohibitively. Difficulties with accounting in FP-7 have added their share.

The transnational access programmes of the EC are a valuable instrument to enable researchers to access existing high-profile facilities and to encourage those facilities to accept and support new users and user groups. The restriction to outside and foreign users (user must not come from a partner of the network and has to cross a border in order to receive financial support) seems somewhat artificial in view of supporting the best science.

The joint discussion revealed that there are a number of cross-cutting non-technical issues that various RI initiatives seem to share, among them the need for a sustainable financial model, the importance of skilled personnel, the benefit of exchange of knowledge and experience and the difficulties associated with data / IP ownership.

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Conclusions and Outlook

The presentations and discussions in the parallel as well as joint sessions of the workshop showed clearly that research infrastructure networks in the two specific subject areas addressed by this workshop, namely field trial sites (FTS) and pilot plants (PP), can offer substantial benefits.

An FTS network might even be the next step in substantially transforming agricultural and related research in view of the upcoming important research questions. For the PP sector increased efficiency might play a major role.

Both FTS and PP expressed the need for follow-up activities as described above at the end of the topical sections. So this workshop can be seen as a useful measure to support networking of these sectors. The presentations showed that there have been successful attempts to networking already, at least on the national level, but that much remains to be done.

The outcome of this workshop will inform the evaluation of the 'networking workshops' activity of the SE WG RI.

The various presentations and conclusions slides are available for consultation at:

http://www.era-instruments.eu/downloads/scienceeurope/gap_analysis/

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Annex A: Programme

Date: 18. - 19. February 2015 **Location:** DFG Head Office, Bonn, Germany

1st day:

12:00 – 13:00 Arrival

13:00 – 14:00 Opening, Introduction, Tour de Table, what are participants expecting?

14:00 – 18:30 Parallel sessions (session 1: Field trial sites, session 2: Pilot plants)

14:00 – 18:00 Short presentations on the present state and future perspectives
with joint coffee break for all participants (ca. 16:00)

Session 1: Field trial sites, Chairs: Dirk Inze and Nicolas Brüggemann

Session 2: Pilot plants, Chair: Guy Marin

18:00 – 18:30 Concluding discussion and possible Next Steps

20:00 Dinner

2nd day:

9:30 – 10:00 Brief presentations of conclusions from the parallel sessions of day 1

10:00 – 11:00 Examples for European networks and partnerships with industry (session 3)

- Abad Chabbi, ESFRI project AnaEE

- Andrew Martin, Integrating Activity BRISK

11:00 – 11:30 Coffee break

11:30 – 12:45 Plenum discussion

12:45 – 13:00 Summary, next steps and Closing

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Session 1: Field Trial Sites

Chairs: Dirk Inze, Nicolas Brüggemann

14:00 Introduction

- | | |
|------------------------------|---|
| 14:10 Hartmut Stützel | DFG scientific committee for Agroecosystem Research, Germany |
| 14:40 Heide Spiegel | AGES, Abteilung: Bodengesundheit & Pflanzenernährung, Austria |
| 15:00 Hilde Nelissen | PSB VIB/UGent, Belgium |
| 15:20 Carlo Grignani | Universita degli studi di Torino, Italy |
| 15:40 Wiesław Oleszek | State Research Institute, Pulawy, Poland |

16:00 Coffee break

- | | |
|-------------------------------|--|
| 16:30 Thomas Kätterer | Swedish University of Agricultural Sciences, Sweden |
| 16:50 Michael Winzeler | Agroscope Institute for Sustainability Sciences (ISS), Switzerland |
| 17:10 Johnathan Napier | Rothamsted GM trial site, UK |

17:30 General discussion and possible next steps

Approx. 19:00 End of session / End of day 1

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Session 2: Pilot Plants

Chair: Guy Marin

14:00 Introduction

14:10 Guy Marin Steam Cracker, Belgium

14:40 Wim Soetaert Bio Base Europe, Belgium

15:10 Gilles Aumont TWB, France

15:30 Killian O'Driscoll NIBRT, Ireland

16:00 Coffee break

16:30 Kieran Hodnett SSPC, Ireland

17:00 Adrian Higson NNFFCC, UK

17:30 General discussion and possible next steps

Approx. 19:00 End of session / End of day 1

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Annex B: List of Participants

First Name	Last Name	Organisation	Country
Gilles	Aumont	INRA	France
Nicolas	Brüggemann	Forschungszentrum Jülich GmbH	Germany
Abad	Chabbi	National Institute of Agronomic Research	France
Gilles	Dubochet	Science Europe	-
Igor	Emri	University of Ljubljana, Faculty of Mechanical Engineering,	Slovenia
Maud	Evrard	Science Europe	-
Andreas	Fangmeier	University of Hohenheim	Germany
Les	Firbank	University of Leeds	UK
Carlo	Grignani	University of Turin, Dep. Agricultural Forest and Food Sciences	Italy
Wilfried	Hermann	University of Hohenheim, Agricultural Experiment Station	Germany
Adrian	Higson	NNFCC - Bioeconomy Consultants	UK
Kieran	Hodnett	Synthesis and Solid State Pharmaceutical Centre	Ireland
Christa	Hooijer	Netherlands Organization for Scientific Research	Netherlands
Dirk	Inzé	VIB/Ghent University	Belgium
Thomas	Kätterer	Swedish University of Agricultural Sciences, Department of Ecology	Sweden
Guy	Marin	Laboratory for Chemical Technology Ghent University	Belgium
Andrew	Martin	Royal Institute of Technology	Sweden
Mike	Morris	BEACON, Aberystwyth University	UK
Christoph	Müller	Uni Giessen	Germany
Johnathan	Napier	Rothamsted Research	UK
Hilde	Nelissen	VIB/Ghent University	Belgium
Odjo	Nestor	I.R.D. - Institut de recherche pour le développement	France
Killian	O Driscoll	National Institute for Bioprocessing Research and Training	Ireland
Jon	O'Halloran	Synthesis and Solid State Pharmaceutical Centre	Ireland
Wieslaw	Oleszek	Institute of Soil Science and Plant Cultivation	Poland
Magdalena	Radwanska	Science Europe	-
Christian	Renner	DFG	Germany
Michel	Royeck	DFG	Germany
Michael	Ryan	Science Foundation Ireland	Ireland
Patricia	Schmitz-Möller	DFG	Germany
Ulrich	Schurr	Research Center Juelich/ German Plant Phenotyping Network (DPPN)	Germany
Jürgen	Schwarz	Julius Kühn Institute, Federal Research Centre for Cultivated Plants	Germany
Wim	Soetaert	Bio Base Europe Pilot Plant	Belgium
Heide	Spiegel	Austrian Agency for Health and Food Safety	Austria
Hartmut	Stützel	Leibniz Universität Hannover	Germany
Michael	Winzeler	Agroscope, Institute for Sustainability Sciences ISS	Switzerland

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Annex C: Organising Committee

Members are:

- Christian Renner (Programme director, DFG, Germany, SE WG RI member) – Task Group leader
- Gilles Aumont (Head of Research Infrastructures, INRA, France, SE WG RI member)
- Merja Särkioja (AKA, Finland, SE WG RI member)
- Hartmut Stützel (Vice-chair of the DFG scientific committee for Agroecosystem Research)
- Maud Evrard (Senior Policy Officer, WG RIs, Science Europe)
- Gilles Dubochet (Senior Science Officer, ENGITECH Committee, Science Europe)
- Magdalena Radwanska (Senior Science Officer, LEGS Committee, Science Europe)

Scientific advisors are:

- Dirk Inze (Ghent University, Belgium, LEGS SC chair)
- Guy Marin (Ghent University, Belgium, ENGITECH SC member)
- Nicolas Brüggemann (Member of the DFG scientific committee for Agroecosystem Research)
- Andreas Fangmeier (Member of the DFG scientific committee for Agroecosystem Research)