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Common Agricultural and wider bioeconomy reSearch Agenda

ASSESSMENT OF ERA-NETs AND COST ACTIONS IN THE EU FOREST-BASED SECTOR

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The overall objective of CASA, a Coordination and Support Action (CSA), is a **consolidated common agricultural and wider bioeconomy research agenda** within the European Research Area.

CASA will achieve this by bringing the Standing Committee on Agricultural Research (SCAR), which has already contributed significantly to this objective in the past, to the next level of performance as a research policy think tank. CASA will efficiently strengthen the strengths and compensate for the insufficiencies of SCAR and thus help it evolve further into 'SCAR plus'.

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1. ERA-NETS AND COST ACTIONS FOSTERING FOREST-RELATED INNOVATION

1.1 Scope and purpose of the study

This study assesses the impact of past and existing ERA-Nets and COST Actions within and related to the European forest-based sector. Its findings contribute to the scope and role of the SCAR strategic group for forests and forestry research and innovation (R&I).

The results provide deeper background and better understanding of the innovation and research activities in the forest-based sector that have been achieved on transnational level. More generally, the results of the study contribute to a better knowledge of particular relevance for the COFUND programming:

- Coordination of national research programmes, towards an integrated European Research Area (ERA)
- Coupling research and innovation
- Removing barriers to innovation
- Practices and achievements of collaboration of public-public and public-private sectors
- Contribution of the sector to the wider circular economy and bioeconomy research

Special attention is given to strengthen and support the SWG FOREST for promoting transnational research and international cooperation in view of the global challenges faced by the European forest-based sector, and to ensure the EU-wide participation and relevance of coordinating actions. The results of the impact analysis are valuable to the discussions on strategic orientation and formulation of research and innovation policies.

COST is the longest running EU-funded programme that enables researchers to develop their own ideas and new initiatives across all fields in science and technology and to set up their interdisciplinary research networks in Europe and beyond.

The ERA-NET instrument was launched within the 5th Framework Programme of the European Commission. In brief it defined common European interests while taking regional and national differences into consideration. ERA-NETs initiate the networking of research activities conducted at national or regional level and the mutual opening of national and regional research programmes to achieve sustained progress and collaboration among European partners and countries.

Today, transnational cooperation is embedded in partly harmonised national policies and processes, in order to be long-lasting. The outcomes and experience show that national programs are well committed to combined efforts. However, there is still a need to widen participation and to develop cooperation procedures in order to fund more European and international level projects from national funds. National research programmes can benefit from

exploring more the possibilities for international cooperation, coordination and sharing of competences and infrastructures in Europe.

Forestry and the forest-based industries are facing international challenges. Therefore the need to fund international research cooperation through national funds is growing. The current situation in the European Union can be described best by highlighting the fact that the majority of all Research, Technological Development and Innovation (RDTI) funding in the EU is sourced on member and associated states level.

The increased focus on sustainable mobilisation and utilisation of EU forests and its products needs to bring the member states' research funding and research policy organisations together to identify more possibilities for joint programming and alignment of research initiatives in areas suitable for transnational collaboration (regional, pan-European or global level). It creates a need for SWG member countries to meet for strategic discussions and planning as well as sharing results and experiences from the forest-related ERA-Nets, COST Actions and other scientific and technological cooperation programmes.

This assessment of the forest-related ERA-NETs[1] and COST actions was focussed on the contents, the thematic fields of the forestry-wood value chains that have been addressed, the financial budgets of the programmes and projects, the partnerships of the cooperation networks, as well as their transfer and implementation into services and industry.

The main outcomes of the study include:

- Compilation of research and innovation projects resulting from coordinated ERA-NET actions of high relevance for the sustainable growth of the economy in EU forest sector
- Identification of main RDTI areas for further joint programming and alignment of research activities based on the state of the art
- Assessment of impacts and benefits of COST activities in bringing together consortia in ERA-NETs funded projects and other ERA-relevant outcomes.

1.2 Europe's forest-based sector in brief

The forest-based sector[2] is a key player in the European Bioeconomy, representing around 35% of its turnover. It contributes around 7-8% of the EU's manufacturing GDP and employs over 3.5 million people within more than 400.000 small and medium size enterprises and multinational corporations (2013). The forest-based sector is built upon woodworking and furniture industries, pulp, paper and converting industries and various forest ownership types (public and private). The sector is based upon around 90% of sustainably mobilised forest biomass from EU forests.

Sustainably managed forests cover 42% of the EU's land area and are a vital for rural economies. Large regional differences in the composition of forests and the linked industries are dominant

[1] The three main ERA-NETs within the European forest-based sector were WoodWisdom-Net, Foresterra and SUMFOREST. All three merged into the new ERA-NET Cofund FORESTVALUE.

[2] Text adapted from: FTP European Forest-Based Sector Technology Platform. www.forestplatform.org

across Europe. Over 250 000 people work in public and private forest enterprises. Europe's multifunctional forests serve and deliver a variety of goods and services.

The driving sub-sector of the forest-based industries in Europe are the **woodworking and furniture industries**. More than 2 million employees work in around 314 000, mostly small and medium-sized companies which generate a total turnover of more than €200 billion (figures for 2011). The woodworking sector comprises sawmilling (15%), wood construction products (37%) and furniture manufacturing (48%). Over 100 million m^3 of sawn timber are produced in the EU, close to two thirds of which came from the five largest producing EU Member States, namely, Germany (21%), Sweden (18%), Finland (10%), Austria (9%) and France (7%) (2015).

Wood is the **number one renewable raw material for the construction and furniture sectors**. Wood products are produced in established, low energy production system, with minimal emissions. Intermediate products from sawmills such as chips and sawdust are transformed into wood based panels. Also wood products can be re-used and recycled. At the end of their valuable life they can be used for bio-energy.

The **pulp and paper industry** is the second large sub-sector with a total turnover of €81 billion and over 177 000 employees in some 620 companies across Europe (2016). The paper industry attained a current recycling rate of around 72%. This has been achieved through progress in paper collection and sorting, recycling and deinking technologies.

The European forest-based sector is developing into a main provider of novel products from non-food feedstock in the near future, e.g. resources from recovered materials. Novel forest-based products are emerging, such as bio-plastics, bio-composites or cellulose biofuels. The sector has also made substantial progress in the areas of biorefinery and nanotechnology.

1.3 Key findings and conclusions of the study

The results of the study highlight the importance of the ERA-NET and COST funding schemes to initiate and implement future-oriented forest-related research and innovation projects through transnational networks and collaborative actions.

A total of **159** ERA-NET actions from 2007 to 2020 were identified, which of 80 projects belong to the main ERA-NETS WoodWisdom, FORESTERRA and SUMFOREST. The main ERA-NETs in the forest-based sector mobilised around **€85 million** of funding, which of more than €70 million came from national funding sources. The total funding from forest-related ERA-NETs can be estimated between **€140-180 million**.

Furthermore, a total of **137** COST actions from 1991 to 2019 were identified, of which 107 belong to the core forest-related domains. The total funding from COST can be estimated with approximately **€75 million**.

The widespread success of these ERA-NETs in facilitating and implementing high quality research and innovation in various important fields of the forest-based sector relates to the unique structure of the funding scheme, which of the following features shall be highlighted:

1. *Flexibility for funding organisations.* The rules for financing projects under the ERA-NET schemes allow for more flexibility by the funding partners to select projects fitting best into their national priorities. The selection of projects by the funding partners is built on scientific and technological excellence and in alignment to national policies. Sharing funding across borders allows partners to participate in research and innovation projects, even if the national funding budget has already reached its limits. Another advantage lies in the flexibility to combine research and development activities with new infrastructure.

2. *Bottom-up approach suited to the forest-based sector.* ERA-NETs respond to the needs and objectives of specific sectors in line with important parts of European policies. They do however not operate as a top-down programming. The ERA-NET scheme thus enables funding partners to launch tailor-made calls with a bottom-up approach, which is a particularly strength for the needs of from the very diverse industry actors and stakeholders in the forest-based sector. It allows to build partnerships among countries facing same regional challenges and engage in strategies for further joint research and development programs.

3. *Boosting European excellence and knowledge in areas of high relevance*. All ERA-NETs successfully set up networks and partnerships in key research areas of relevance to the forest-based sector. They thus helped to address major trends, challenges and important market barriers through enhanced research and innovation capacity, for example in forest disturbances, ecosystem services, wood materials, wood construction and novel wood products, recycling, biotechnology and biorefineries, among others. Most of the actions triggered further RTD collaboration beyond the life-time of the ERA-NET funding.

4. *Participation of new member states*. With the enlargement of the EU in 2005, ERA-NETs and COST helped a big deal to facilitate the partnership and incorporation of research and technology actors from Central and Eastern Europe, who needed time for the integration in the EC Framework Programmes. Partners from these regions benefitted from exchange, mobility and modernisation of infrastructures. Wider participation also helped to motivate actors for larger projects and other instruments of the EC framework programs.

5. *International outreach*. A key asset of the ERA-NET scheme is that it allows the participation of partners from countries and regions outside the European Union with shared interests in national funded research and development. This has enabled numerous consortia and research groups in the forest-based sector to build up leading competencies and strong networks fostering innovative collaboration and exchange in their fields.

6. *Industry participation*. Market oriented research and development could be realised better through ERA-NET funded projects in areas of common interest. The majority of ERA-NET funded projects involved many industry partners and guaranteed a transfer of knowledge already during the life-time of the project itself. Innovations were established through cross-border transfer and sharing of knowledge and cooperation. A high market impact (short and medium term) is guaranteed as the partnership in ERA-NET projects is built upon a small group of experts in (very) specific fields.

7. *Manageable projects*. There is less red tape in ERA-NET funded projects for the partners involved. The average duration of a project suits perfectly to address a technological problem with research and development collaboration. As several examples from the past

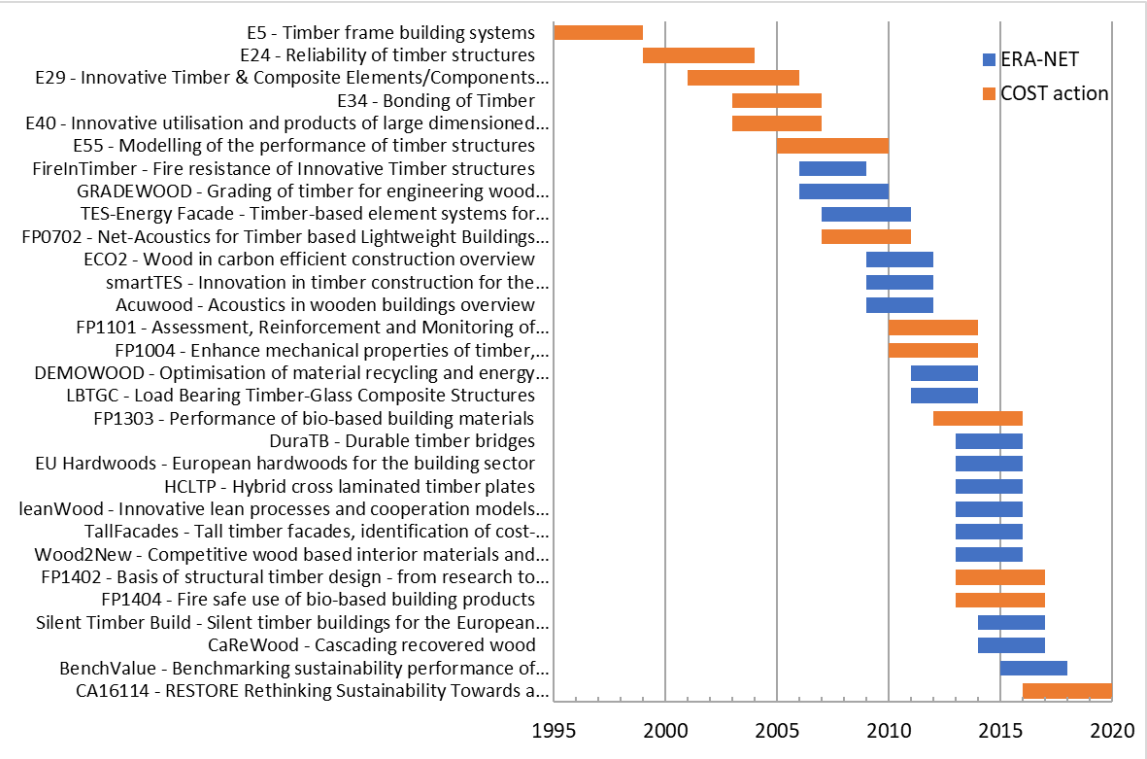
ERA-NETs have shown, the preparation of a proposal and the management of a project can also be handled by SMEs (and not only by an experienced, large RTDI performer). The reporting can be done in the native language to the national funding and follows established national rules and procedures. Special experience or training is less required or less time consuming compared to other, new funding instruments under the European Framework Programs.

8. *Research efficiency and European complementarity*. The collaborative structure of ERA-NET joint calls not only facilitates effective transnational research, but also allows national funding agencies to close gaps in certain areas of expertise in view of the broad forest-related domain, and avoid the kind of wasteful overlaps in project content that can occur when national teams work independently on similar fields.

9. *Role of COST actions*: The review of the COST framework has played a major role in preparing the ground for the manifold partnerships and leading research and innovation actions in the forest-based sector. The evolution of important thematic fields and industry trends can be linked to a series of European actions such as COST actions, ERA-NETs and other framework projects, which have paved the way for leading advances and progress through transnational collaboration in research and development (cf. Figure 1).

In conclusion, it has to be underlined that specifically for the European forest-based sector, which is largely composed of SMEs, the ERA-NET scheme has been the essential backbone for research and development activities. Specifically the WoodWisdom-NETs focussed on wood technologies and RTDI projects of high scientific excellence with a huge market relevance for woodworking industries as well as for the pulp and paper, bioenergy and biorefinery value chains. The ERA-NET scheme has proven to be the perfect instrument for bottom-up, well-tailored research and innovation actions fostering considerable transfer and market impact. European-level research and development actions are well-suited for the forest-based sector, because many questions can be considered too specific or ‘small’ to be addressed appropriately through specific national funding programmes.

Fig. 1 Series of ERA-Nets and COST actions in the field of wood construction, 1995-2020



Website links of actions E5, E24, E29, E34, E40, E55, FireInTimber, GRADEWOOD, TES-Energy Facade, FP0702, ECO2, smartTES, Acuwood, FP1101, FP1004, DEMOWOOD, LBTGC, FP1303, Wood2New, EU Hardwoods, TallFacades, DuraTB, HCLTP, leanWood, FP1404, FP1402, Silent Timber Build, CaReWood, BenchValue, CA16114 RESTORE

2.
ERA-NETS IN EUROPE'S FOREST-BASED SECTOR

2.1 Evolution of the EU Framework Programmes and the ERA

The European Commission's Framework Programmes have in general two main strategic objectives: first to strengthen the scientific and technological base of European industry, and second, to encourage its international competitiveness, while promoting research that supports EU policies. A main purpose behind all Framework Programmes is the creation of the European Research Area (ERA) to strengthen Europe's position in the global landscape of knowledge creation and innovation.

- The Fifth Framework Programme (FP5, 1998-2002, budget €15 billion) set out the priorities for the EU's research, technological development and demonstration (RTD), fostering increasing industrial competitiveness and the quality of life for European citizens. Focused on different research areas, a major innovation of FP5 were 'Key actions' to address a specific problem through cooperation not only between scientific and technological disciplines, but also between programs and the organisations concerned.

- The Sixth Framework Programme (FP6, 2002-2006, budget €18 billion) put a combined focus on science, research and innovation to overcome national fragmentation of research and contribute to the ERA. Research was targeted at strengthening of economic competitiveness, solving major societal questions and supporting the implementation of EU policies. FP6 activities had to comply with ethical principles and strive both to increase the role of women in research and to improve information for and dialogue with society.

- The Seventh Framework Programme (FP7, 2007-2013, budget €50 billion), which more than doubled its budget compared to FP6, reflected the high priority of research to respond to Europe's needs for jobs and competitiveness, and to maintain leadership in the global knowledge economy. FP7-funded activities required a 'European added value' to complement national research programmes. A key aspect was the trans-nationality of consortia built of partners from different EU countries and regions and fostering mobility over national borders. Secondly, FP7 permitted to raise the competition between scientists in fundamental 'frontier' research from the national to the European level.

- Horizon 2020 (H2020, 2014-2020, budget €80 billion) is the largest EU Research and Innovation (R&I) programme ever, implementing Europe's 2020 flagship initiative the 'Innovation Union', aimed at securing global competitiveness and taking great ideas from the lab to the market as a means to drive economic growth and create jobs. H2020 puts its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure that Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work and invest together in order to create a genuine single market for knowledge, research and innovation.

The ERA-NET scheme was set up at the end of FP5 to develop synergies for research at European level also beyond the EU RTD Framework Programme. The instrument allows national research funding bodies to coordinate jointly-funded research programmes across borders. Programme owners are typically national/regional ministries/authorities responsible for defining, financing or managing research programmes carried out at national or regional level. Programme managers are typically research councils or funding agencies or other national or regional organisations that implement research programmes under the supervision of the programme owner[3].

Working together across national boundaries allows to address transnational research challenges (e.g. infectious diseases) in an efficient and effective manner and improve quality of life for European citizens. The past experience and empirical evidence proves that the ERA-today has developed today into a truly integrated market for research, technological development and innovation. The ERA-NET scheme is one of the very successful instruments to develop common framework conditions for national and European research promotion and funding and foster an emerging European research and innovation system.

2.2 Overview of forest-related ERA-NETs

2.2.1 WoodWisdom-Net

Since 2004, the ERA-NET WoodWisdom-Net has facilitated the European coordination of national research programmes in the area of wood material science, engineering and forest-based value chains. The ERA-NET WoodWisdom-Net was initiated under FP6. The 1st Joint Call was launched in November 2006 and the first projects started in late 2007.

In its second phase, the ERA-Net continued under FP7as WoodWisdom-Net 2. Two joint calls were launched. The 2nd Joint Call was titled 'Sustainable competitive processing and end-use concepts for forest based industries' and was launched in November 2009. The 3rd Joint Call was organised together with the ERA-NET Bioenergy under the title 'Sustainable forest management and optimised use of ligno-cellulosic resources – Bridging gaps between research disciplines, producers, consumers and society" and it was launched in November 2010.

Then WoodWisdom-Net+ continued under the FP7 ERA-NET Plus scheme. The 4th Joint Call was launched in February 2013. The overall scope of WWNet+ was to support the total transformation of the European forest-based industry and sustainable forest management to enable it to increase resource efficiency and develop a totally new products scope, while adapting to and mitigating the impacts of climate change.

Most of the 23 projects focussed on the themes 'value added products" (10), 'industrial processes" (7), and 'competitive customer solutions" (5), while only one project belongs to 'sustainable management of forest resources". However, all proposals indicated that their research is connected to more than just one of the listed research areas.

[3] H2020 Online Manual. ERA-NETs.
http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/era-net_en.htm

Table 1 Overview of the ERA-NET WoodWisdom-Net Joint Calls from 2004-2017

ERA-NET parameter	WW-Net 1st Joint Call	WW-Net 2 2nd Joint Call	WW-Net 2 3rd Joint Call	WW-Net+ 4th Joint Call
ERA-NET duration	2004-2008	2009-2012		2012-2017
ERA-NET partners	19	19		20
ERA-NET countries	9	12		12
Projects duration	2007-2011	2010-2014	2011-2014	2014-2018
1st stage proposals	74	38	81	80
2nd stage proposals	45		40	33
Funded projects	17	9	13	23
National funding	20 M€	13 M€	20 M€	20 M€
EU ERA-NET funding	2 M€	1 M€		
EU co-funding				8 M€
Total funding volume	22 M€	14 M€	20 M€	28 M€

Today, WoodWisdom-Net has further evolved into the ERA-NET COFUND 'ForestValue', which is a joint initiative of WoodWisdom together with the ERA-NETs FORESTERRA and SUMFOREST.

2.2.2 FORESTERRA

FORESTERRA is a unique 'regional' ERA-NET focussed on research that addresses challenges of forest ecosystems around the Mediterranean Sea. It was funded under FP7 from 2012 to 2015 with an EU contribution of €1.9 million. The total costs were €2.5 million.

It connects funding partners from 12 Mediterranean countries Portugal, Spain, France, Italy, Slovenia, Croatia, Greece, Bulgaria, Turkey, Tunisia, Algeria, and Morocco, as well as two international institutions, the European Forest Institute (EFI) and the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM). FORESTERRA also reached out internationally to countries with comparable climatic conditions, e.g. Australia, California, Chile and South Africa. Some of the partner countries actively participated to produce a Mediterranean Forest Research Agenda (MFRA) launched in 2009 in Marrakesh, Morocco.

FORESTERRA focused on activities of mapping and information exchange, common strategic activities and implementation of joint activities to consolidate the partnerships. One joint call for research projects was launched in 2013 and in total two projects were funded for the period from 2014 to 2017.

2.2.3 SUMFOREST

SUMFOREST focuses on climatic and environmental changes that lead to socio-economic and land-use changes and pose challenges for multifunctional demands on European forest resources and their sustainable management. It was funded under FP7-KBBE from 2014 to 2017 with an EU contribution of €2.0 million. The total costs were €2.2 million.

The aim of this ERA-NET is reinforcing scientific cooperation on European forests, which will also build new cooperation arrangements with EU neighbourhood regions, aiming at a reduced fragmentation and maximised impact of research activities on sustainable forest management and multifunctional forestry.

SUMFOREST established a powerful network bringing together 23 key actors from 15 European member states, 3 associated states and 2 international institutions, and also reached out to a large group of other ERA-NETS, FP7 projects and COST actions.

One joint call was launched in 2016. Seven out of 26 eligible proposals received funding (27%) for the period from 2016 to 2020. The anticipated sum requested for public funding is €8.3 million, which corresponds to 84% of the available earmarked common budget of €9.9 million.

2.2.4 Other ERA-NETs with forest-related topics

Various other ERA-nets have also have promoted transnational collaboration in research fields, which also are of relevance for forest ecosystems, biodiversity and forest-based products innovation. The funded projects usually have a wider scope or target a different sector, but include topics that are also important for parts of the forest-based sector.

BiodivERsA is a network of national and regional funding organisations promoting pan-European research on biodiversity and ecosystem services, offering innovative opportunities for the conservation and sustainable management of biodiversity. It was started under FP6 in 2005. Six joint calls have been launched for over €80 million.

Other important ERA-NETs of relevance include, among others, e.g. the ERA-IB in industrial biotechnology, Euphresco in phytosanitary research or FACCE ERA-GAS in greenhouse gas monitoring and mitigation.

2.3 Main results of the assessment

2.3.1 Data sources and methodology

The PLATFORM database[4] was contains a collection of all ERA-NETs within the context of the bioeconomy. Using a broad keyword search, all ERA-NET projects addressing various industries and topics of interest of the forest-based sector were identified and reviewed. A database was created, in which all projects were categorised according to three levels of relevance:

a) *High relevance*: The scope of the project lies completely within the forest-based sector, and it fully targets a specific research field or industry in the sector.
b) *Medium relevance:* The scope of the project lies partially in the sector. It addresses an important or interesting aspect which is of relevance for the sector, but the overall scope is generally wider and often puts a focus on other industries.

[4] PLATFORM of Bioeconomy ERA-NET Actions; http://era-platform.eu/

c) *Low relevance*: The project includes only a few aspects which could be of interest to the forest-based sector, but the main activities are irrelevant.

The projects were assigned to thematic fields of five main industry subgroups in the sector:

1. Forestry
2. Wood industries
3. Paper industries
4. Biorefineries, bioenergy, bio-based products (novel forest-based industries)
5. Other industries/sectors (with partial relevance to forest-based sector)

The following information on each projects were collected, as far as available: i) Coordinator (name, institute and country), ii) budget , iii) duration of the project, iv) participants (institute and country), v) number of industrial participants.

2.3.2 Overview of relevant ERA-NET actions

A total number of 303 ERA-NET actions was identified according to these selection criteria (cf. list in Annex 4.3). Among these, 114 projects are of high relevance, 45 of medium relevance and 144 of low relevance. The projects of low relevance were not analysed any further, so a total of number of 159 projects were considered in the assessment (Table 2).

Table 2 Actions per ERA-NET and industry value chain in the forest-based sector

ERA-NET	Projects' year range	Relevance		Industry					Total
		High	Medium	Forestry	Wood	Paper	Bio-*	Other#	
WoodWisdom-Net	2007 – 2011	17		4	8	2	3		17
WoodWisdom-Net 2	2010 – 2014	9			7	1	1		9
WoodWisdom-Net 2 and ERA-NET Bioenergy	2007 – 2017	22		8	1	1	12		22
WoodWisdom-Net Plus	2014 – 2018	23		2	12	1	8		23
SUMFOREST	2016 – 2020	7		6	1				7
FORESTERRA	2014 – 2017	2		2					2
BiodivERsA	2009 – 2020	14	16	15				15	30
Other ERA-NETS	1996 – 2020	20	29	16	1	1	10	21	49
ERA-NETS total		114	45	53	30	6	34	36	159
High relevance				48	30	6	30		114
Medium relevance				5			4	36	45

* includes novel fields such as biorefineries, bioenergy, bio-based products
# includes actions focused on other sectors with some relevance for the FBS

The largest share of actions belong to forestry, including all FORESTERRA, BiodivERsA and almost all SUMFOREST projects. The actions related to wood, paper, biorefinery industries belong to the WoodWisdom as well as other ERANETS. The actions related to other sectors are found under the BiodivERsA and other ERANETS and are all only of medium relevance (Fig. 2).

A high number of countries has participated in the ERA-NET actions, which cover almost all EU members states and various international countries of strategic interest (Fig. 3).

Fig. 2 Distribution of projects per the different ERA-NET Joint Calls

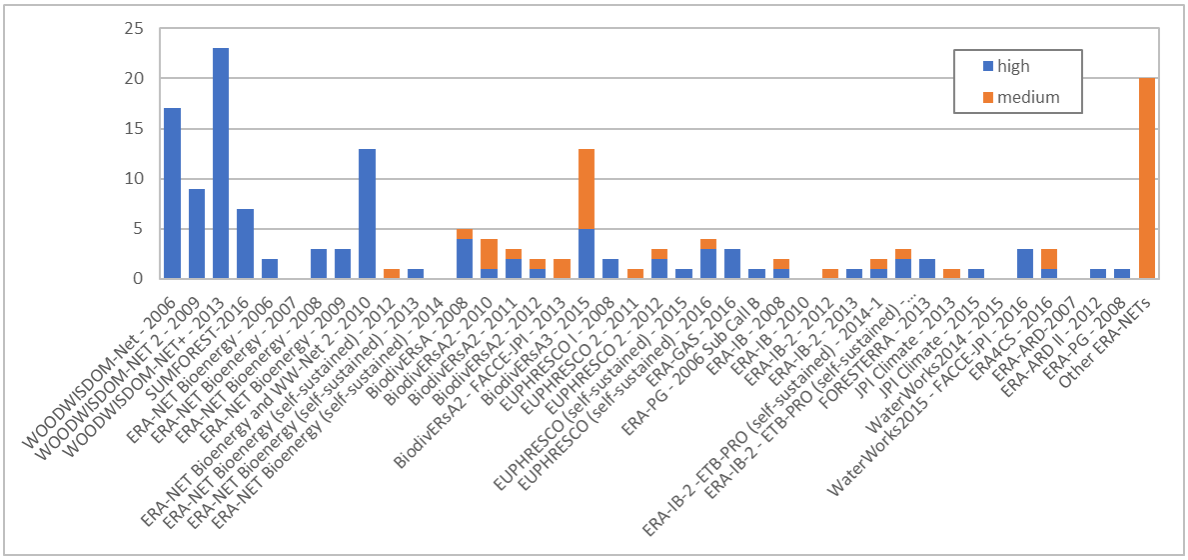


Fig. 3 Distribution of ERA-Net projects per participating country and relevance

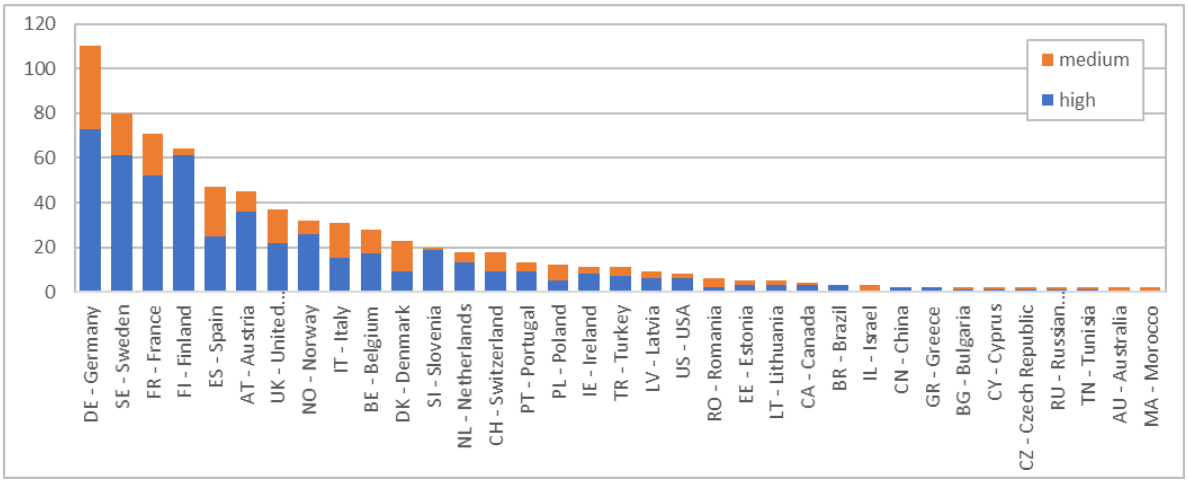


Fig. 4 Distribution of ERA-Net projects per country of the coordinator and their relevance

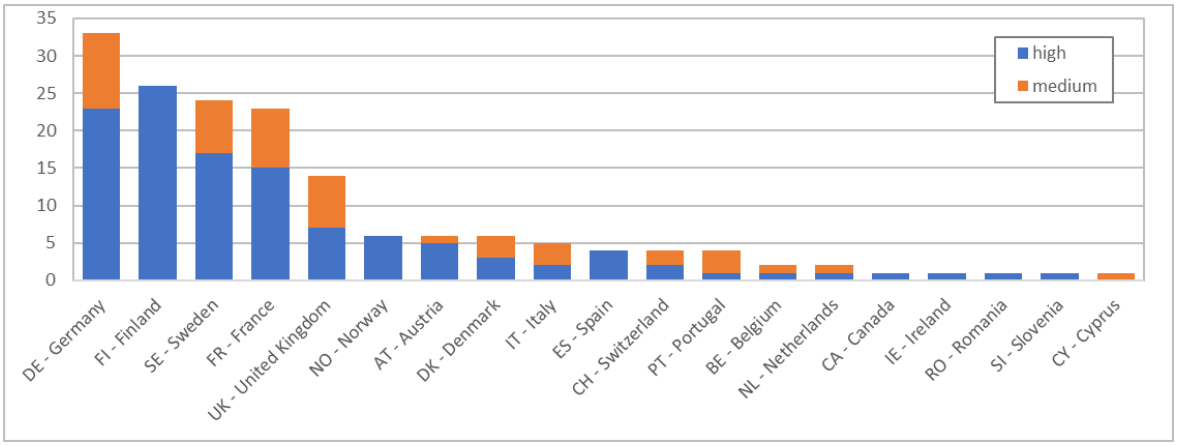
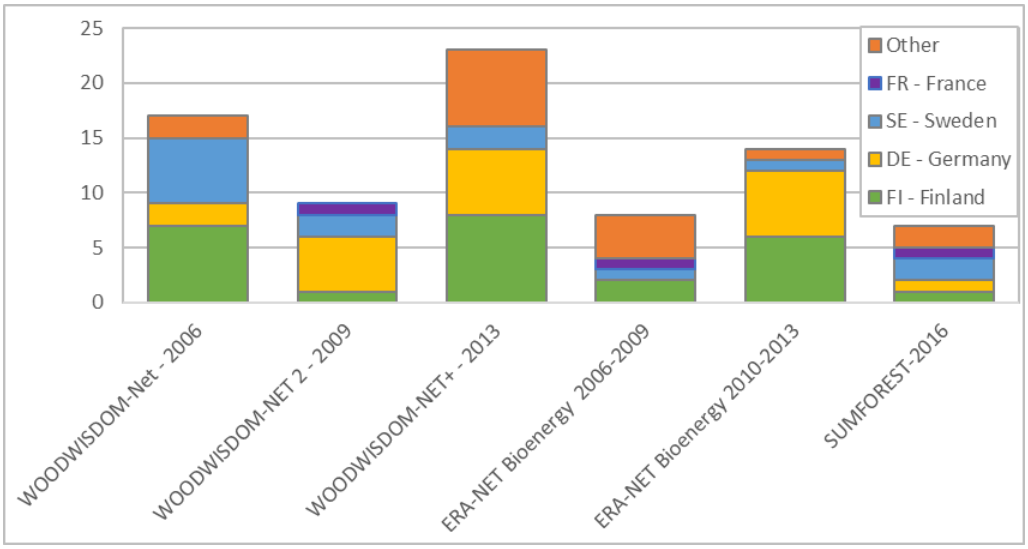


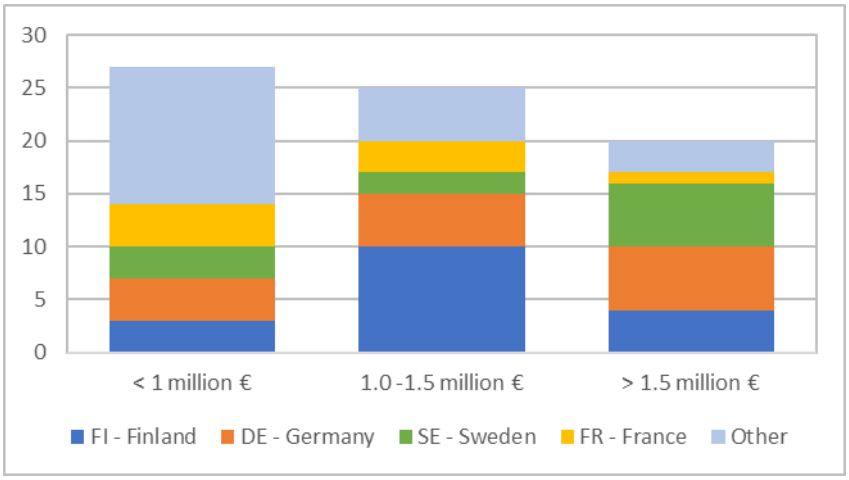
Fig. 5 Distribution of ERA-Net projects per coordinating country and selected ERA-NET call



More than 100 projects (1/3 of all identified projects) of high and medium relevance are coordinated by the four countries Germany, Finland, Sweden and France. Further important leading countries are the UK, Norway, Austria, Denmark, Italy and Spain (Fig. 4, Fig. 5).

The leading coordinating countries are also reflected in the funding budgets of these partner countries (Fig. 6). There is a high participation from a handful of European countries for projects with high relevance for the forest-based sector. 2/3 of projects with a total budget of more than 1 million € are coordinated either by Finland, Germany or Sweden, and also more than 1/3 of projects with a budget of less than 1 million € are coordinated by organisation from these countries.

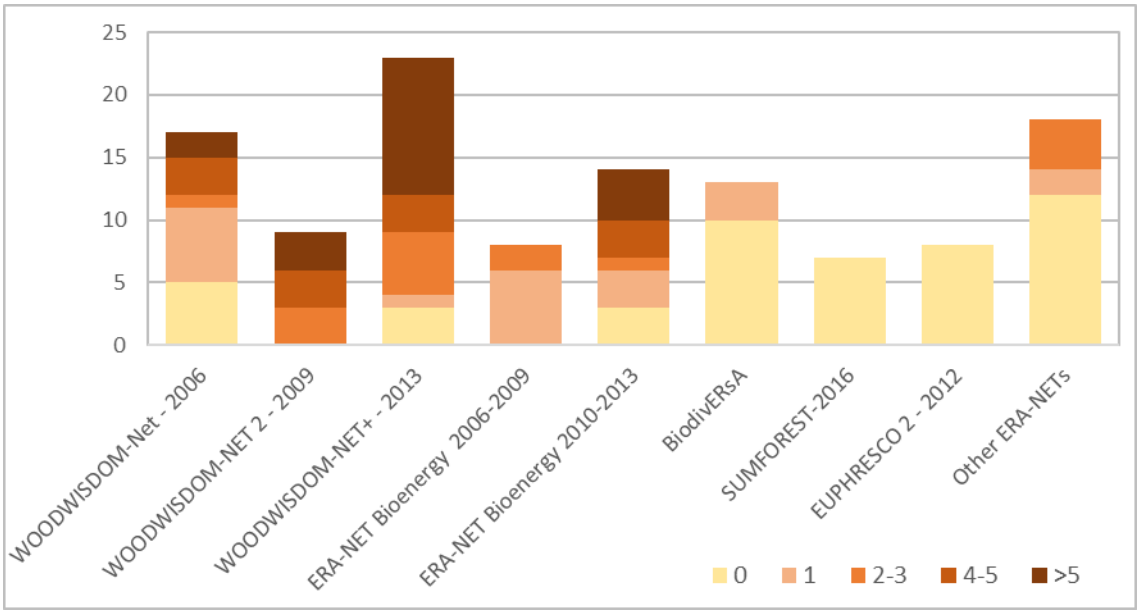
Fig. 6 Distribution of ERA-Net projects per budget size class and per coordinating country



* Note: The graphic refers to 72 projects, because budget information is not available for all projects.

Among the highly relevant projects, a major participation of industrial partners is notable (Fig. 7). In the last WOODWISDOM-NET PLUS call, nearly 50% of all projects (11/23) included at least 5 partners from industry. In comparison

Fig. 7 Distribution of ERA-NET projects with industrial participants per ERA-NET call



* Note: Project counts are categorized according to the number of industrial partners per project.

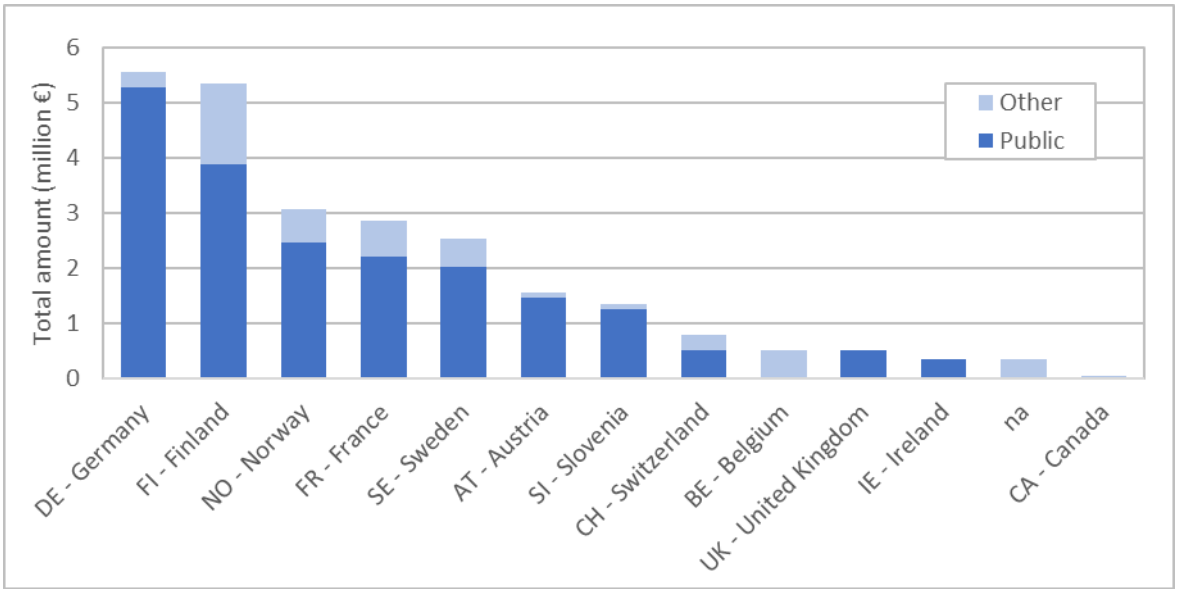
2.3.3 A closer analysis of WoodWisdom-Net+ projects

The final reports of the 23 projects funded under the WoodWisdom-Net+ call 2013 were analysed in more detail. The total funding budget spent sums up to over 27 million euros. In the further analysis, only 21 projects with a total of 25 million euros are considered[5]. A distinction between direct public funding and 'other funding' was considered. This latter group includes co-financing from industrial participants and from institutional internal sources.

The total budgets per project varied between 0.5 million and 2.1 million euros, with an average of 1.2 million euros. The largest contributors to the call's funding have been Germany, Finland, Norway, France and Sweden (Fig. 8).

The projects were funded in average by 80% from public and 20% from other funding sources. However, there are considerable variations: while 9 projects[6] were funded between 95-100% from direct public funding sources, also 5 projects[7] can be identified which had only 52-67% of public funding and hence a major participation from industry. The largest contributions from other funding sources were found in Finland, Norway, France and Sweden (Fig. 8, 9).

Fig. 8 Distribution of funding from the WoodWisdom-NET+ per country and source

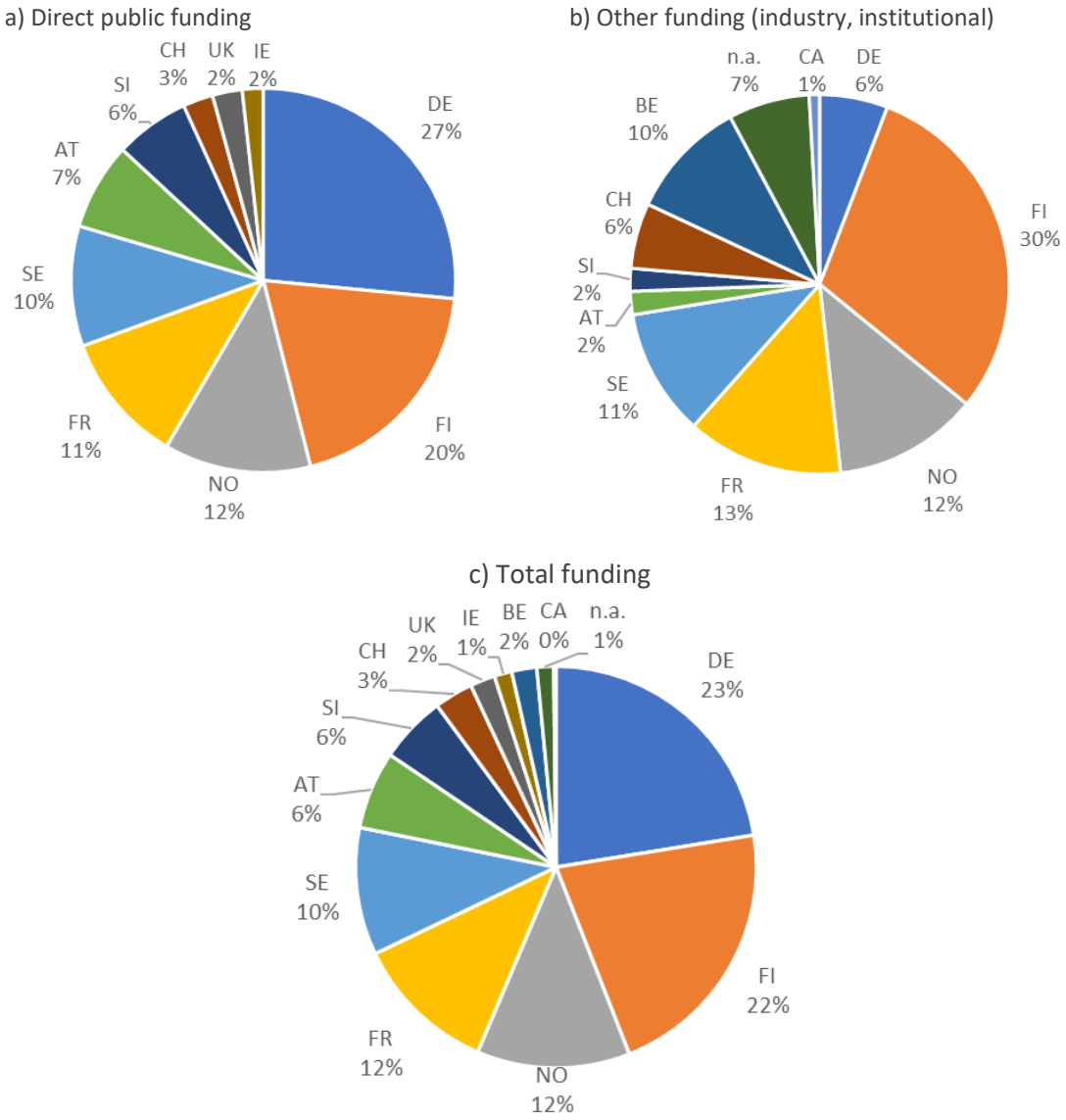


[5] The two projects 'PRONANOCELL' and 'PShapes' were lacking sufficient info on budget details.

[6] Biocopol, CaReWood, Compac, EU Hardwoods, Fastforests, Hemicell, LignoHTL, Tall Facades, Tunable Films

[7] DuraTB, Silent Timber, Varma, Wood2New, WoTIM

Fig. 9 Relative distribution of funding from the WoodWisdom-NET+ per country and source



The WoodWisdom-Net+ final reports portray a variety of results and outcomes of major importance for research progress in the various domains in the forest-based sector. A few additional statistics of achievements allow to highlight this impact for research:

- **26** PhD theses
- More than **80** other degrees
- More **250** publications in journals or conference proceedings with peer review
- More than **150** other publications

2.4 Outlook: ERA-NET Cofund 'ForestValue' and future actions

The new ERA-NET Cofund 'ForestValue – Innovating the forest-based bioeconomy'[8] aims to promote increased innovation and competitiveness of the forest-based sector in Europe and support its transformation from a resource-intensive to a knowledge-intensive, productive, resource-efficient and resilient sector. Sustainability and modernisation of forestry systems and downstream value chains including innovative business concepts and production technologies will be needed to develop the forestry sector and the European bioeconomy, of which forestry accounts for a large share.

The consortium consists of 31 partners representing different programmes in the bioeconomy funding sector, from different regions and countries inside/outside Europe. ForestValue builds on the success of three forest-based ERA-NETs: WoodWisdom-Net (since 2004, WoodWisdom-Net+ 2012-2017), SUMFOREST (2014-2017) and FORESTERRA (2012-2015).

In total, these three ERA-NETs behind ForestValue have had national investments of around **€67 million** to a variety of trans-national co-funded RDI projects (**64** funded projects), the total volume of these projects being around **€86 million**.

Now, after the joint effort under the ForestValue ERA-NET Cofund, the total volume of national investments is expected to grow with another €25 million, which means that since the first ERA-NET in 2004 the total national investments into forest research through these networks of national funders will be up to more than **€100 million**.

The first Joint Call was launched in 2016 and 114 preproposals were received until the first stage deadline. The majority (about 70%) of the pre-proposals were assigned in the thematic research area B 'Innovative industrial production and processing technologies, products, concepts and services'. The call's second stage was opened in May 2018. The first projects are expected to be launched in the beginning of 2019 (info of May 2018).

[8] https://forestvalue.org/about-foresvalue/

3. COST ACTIONS IN EUROPE'S FOREST-BASED SECTOR

3.1 The COST framework

Since its creation in 1971, the European Cooperation in Science and Technology (COST) framework is the longest running EU-funded programme that enables researchers to develop their own ideas and new initiatives across all fields in science and technology and to set up their interdisciplinary research networks in Europe and beyond.

It is a unique means to jointly develop own ideas and new initiatives across all fields in science and technology, including social sciences and humanities, through pan-European networking of nationally funded research activities. Based on a European intergovernmental framework for cooperation in science and technology, COST has been contributing to closing the gap between science, policy makers and society throughout Europe and beyond.

As a precursor of advanced multidisciplinary research, COST plays a very important role in building a European Research Area (ERA). It anticipates and complements the activities of the EU Framework Programmes. It also increases the mobility of researchers across Europe and fosters the establishment of scientific excellence.

The former science organisation which was structured into nine science and technology domains has been replaced by a new organisation aiming at guaranteeing a fully open and bottom-up approach through the establishment of a single Scientific Committee. This also includes a renewed evaluation and selection procedure aiming at identifying breakthrough ideas and favouring interdisciplinary and multidisciplinary projects.

3.2 Main results of the assessment

3.2.1 Overview of relevant COST actions

The COST database was reviewed with help from the COST office in Brussels. 137 COST actions have been identified over the period from 1990-2017 (cf. list in Annex 4.3).

The actions were categorised according to their relevance and the thematic fields of five main industry subgroups of the sector following the same methodology as the ERA-NETS (cf. chapter 2.3.1; see Table 3).

Fig. 10 COST actions per industry

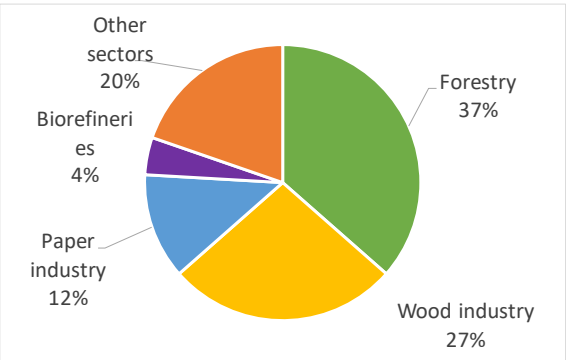


Table 3 COST actions per domain and industry value chain in the forest-based sector

COST domain	Projects' lifetime	Relevance		Industry					Total
	earliest to latest	high	medium	Forestry	Wood	Paper	Bio-*	Other#	
COST FPS	1994 – 2011	52		19	21	12			52
COST FP	2007 – 2019	46		26	12	5	3		46
COST CA	2016 – 2021	4	5	2	2			5	9
Other COST domains	1991 – 2019	8	22	3	2		3	22	30
COST total		110	27	50	37	17	6	27	137

* includes novel fields such as biorefineries, bioenergy, bio-based products
# includes actions focused on other sectors with medium relevance for the FBS

A majority of 50 COST actions (36%) focussed on forestry topics., while 37 actions (27%) relate to wood industries and 17 to paper industries (12%). A small number of 6 actions addressed topics in novel uses (4%). In total, these 110 actions address topics of high relevance for the forest-based sector. A further 27 actions (20%) are related to other industries not directly affiliated with the sector, which however address topics of medium relevance.

3.2.2 Characteristics of COST actions in the forest-based sector

A subset of 22 final reports of COST actions provided by the COST office was reviewed. The reports varied a lot in content and quality, which is why not a lot of consistent data could be retrieved. The following typical characteristics of COST actions in the FBS can be summarised as general indications:

- The identified COST actions included between 5 to 47 country representatives as members (min-max). The average number has been circa 20 members. Over time, the actions grew in the number of members. In the earlier phase from 1990-1999, the average number of members was 16. In the phase 2000-2009, the average was 21. In the latest phase 2010-2017, the average number was 28. The average number of members from associated and international countries is between 2 to 5.
- The COST actions where chaired by scientists from this top ten list of countries (in decreasing order): Finland 15, UK 15, Austria 14, France 13, Germany 9, Italy 8, Sweden 8, Netherlands 7, Spain 5, Belgium 5. (Note that the real figures may be higher, as in number of reports from early actions the chair was not identified.)
- Few available data indicates that up to 100 scientists could become involved in the management committees of one COST action. In total several hundred (up to 300-400) individuals could become involved in total in one cost action.
- The number of Short-Term Scientific Missions varies a lot. As average 20 STSM per COST action seem plausible. Up to 40 per one action have been reported. The number of trainings per COST action was around 3 to 10.

- The number of publications produced within a COST action ranges from 6 to 36 peer-reviewed scientific publications. As average around 20-25 seems plausible. Also a number of various other publications (up to 40 or more) have been reported, including project reports and working documents.
- The few available data indicate the following total budgets per COST action (4-years project). Budgets range between 370 k€ to 768 k€. Budgets have increased over the years. Since 2012, all actions had budgets of more than 600k€. The total funding for the 137 COST actions can thus be estimated with approximately €75 million.

3.2.3 Country participation

Organisations from 36 European countries participated in the COST actions since 1990 (Fig. 11). The top ten countries all were represented in more than 80 COST actions. It is also notable that almost all countries have been engaged in actions in all sub-industries of the forest-based sector.

Furthermore, the COST actions have been successful in promoting outreach to the international science community, including countries with important forest resources and leading science centres (Fig.12). Those countries show a more selective participation, especially in actions focussed on paper and biorefinery industries. A group of countries participated only in forestry-related actions.

Fig. 2 Cumulative number of country participations in COST actions in the forest-based sector per European countries (137 selected actions, 1990-2017)

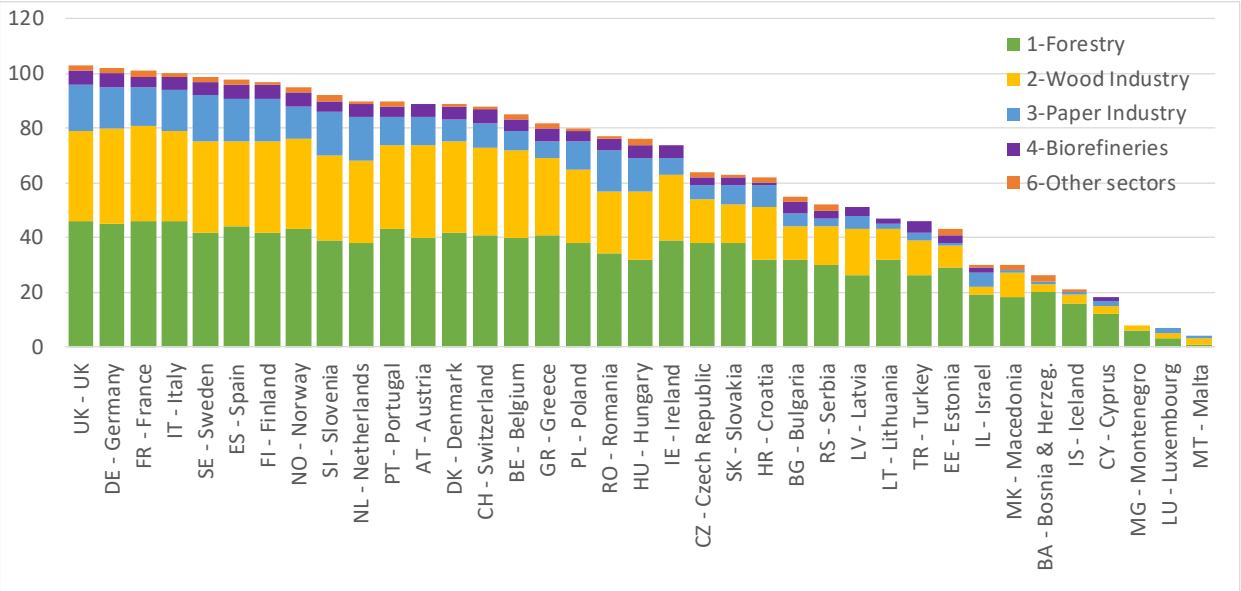
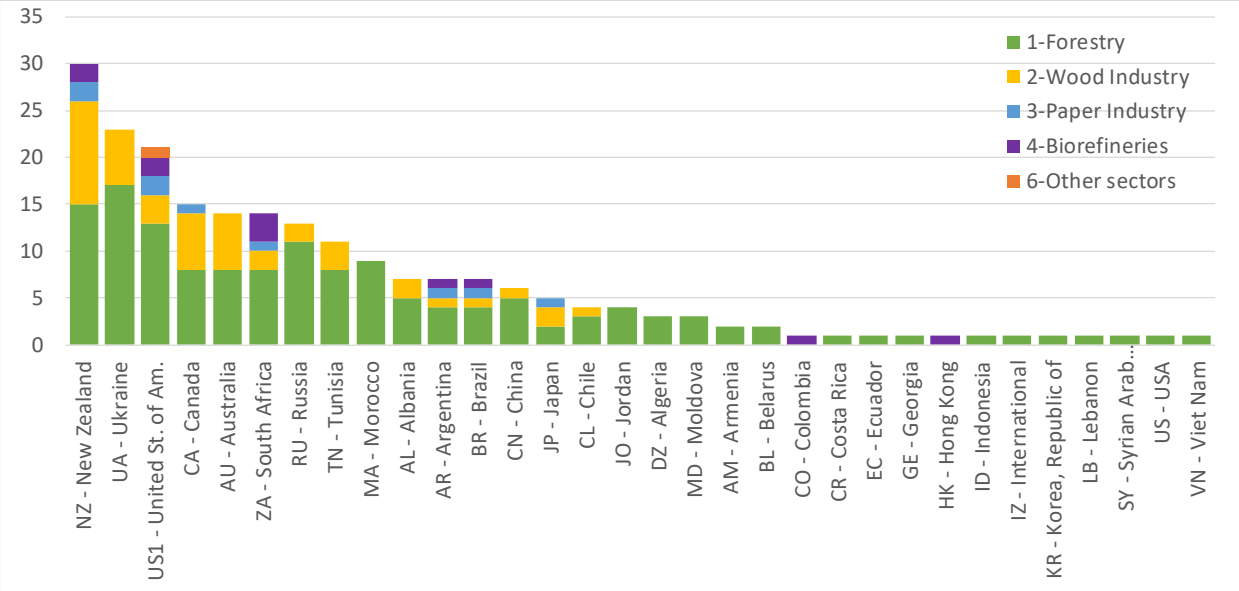


Fig. 32 Cumulative number of country participations in COST actions in the forest-based sector per international and associated countries (137 selected actions, 1990-2017)



3.2.4 Main thematic fields and trends

Time series were analysed to reveal the trends of COST actions per subgroup and topic. The following graphs show the cumulative frequency of the number of COST actions that have been active per year (actions typically have a duration of 4 years). The graphs reveal the emerging and decreasing importance of specific research fields over time.

Fig. 13 shows the full distribution of the total 137 identified COST actions. The number of actions has increased continuously, with a first peak in 2006 and a second in 2015. After 2015, a rapid decline recognised, which shows that barely many new COST actions have been initiated in the FBS in the last years. The still ongoing actions will end latest in 2020.

The review allows a more detailed look on research topics addressed by the actions (Fig. 14). While some topics have been addressed in more than eight actions (e.g. forest pests and disturbances) or even more than 12 action (e.g. wood materials, wood construction), the largest number of topics are usually addressed by six or less actions.

Fig. 43 Frequency of COST actions in the forest-based sector per industry subgroup, 1990-2017

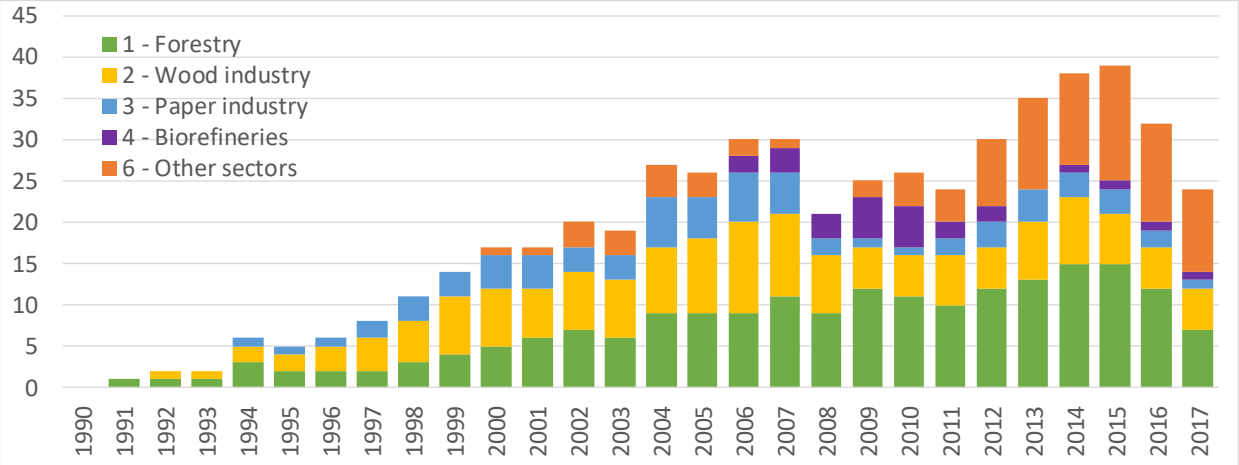
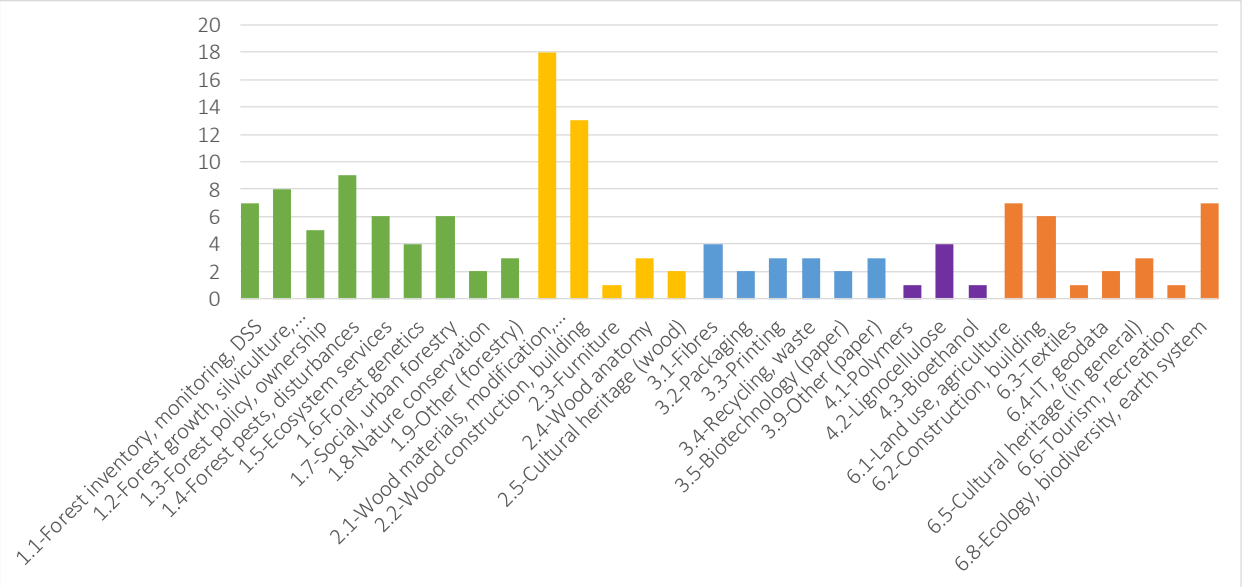


Fig. 54 Frequency of COST actions in the forest-based sector per thematic field (137 actions, period 1990-2017)



The forestry-related actions (Fig. 15) have gradually increased over the past decades: a total of 15 actions were running in parallel in 2015. While the four main thematic fields (1.1, 1.2, 1.3, 1.4) have been represented almost continuously, other fields reveal some shifts, e.g. actions solely focussed on nature conservation (1.8) occurred only until 2015, where after a more comprehensive view e.g. on ecosystem services (1.5) has emerged from 2016 onwards.

Fig. 65 Frequency of forestry-related COST actions, 1990-2017

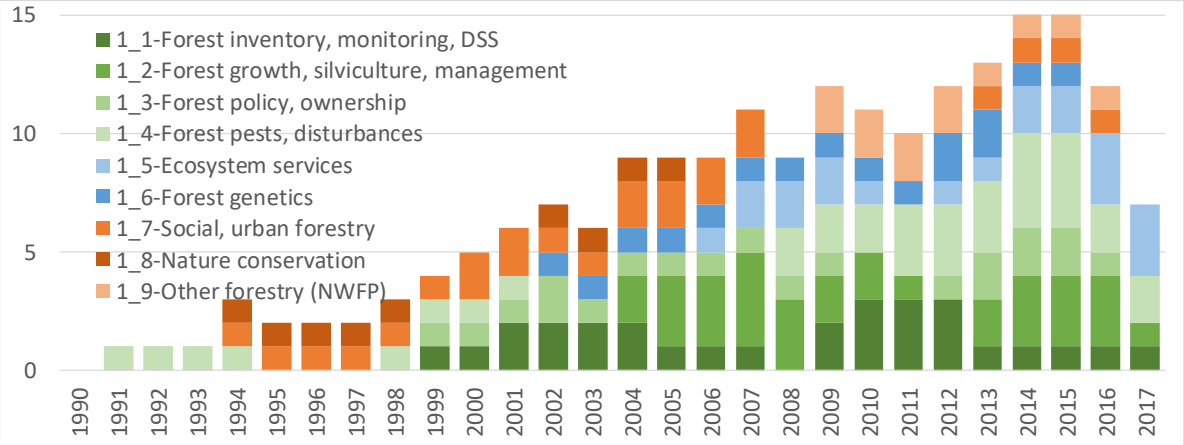
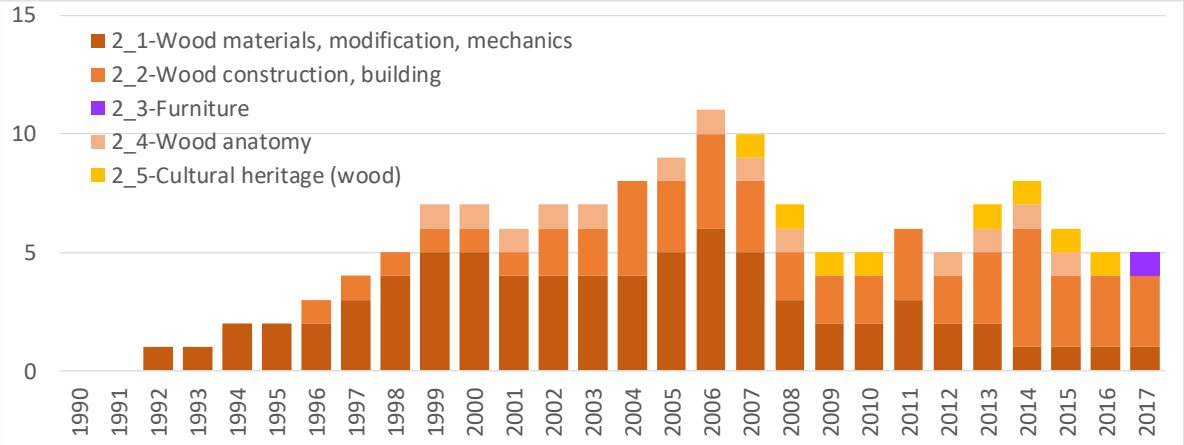


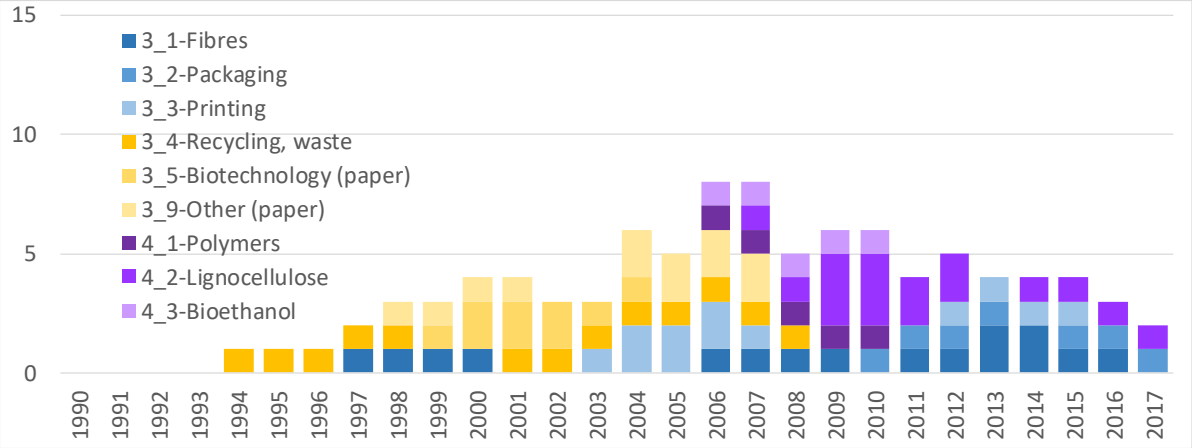
Fig. 7 Frequency of wood industry-related COST actions, 1990-2017



The actions of relevance for the wood industry (Fig. 16) had their peak in 2006, when 11 actions were still running at the same time. After a sharp drop, a second smaller peak occurred in 2014. Since then, the number of active actions has decreased continuously.

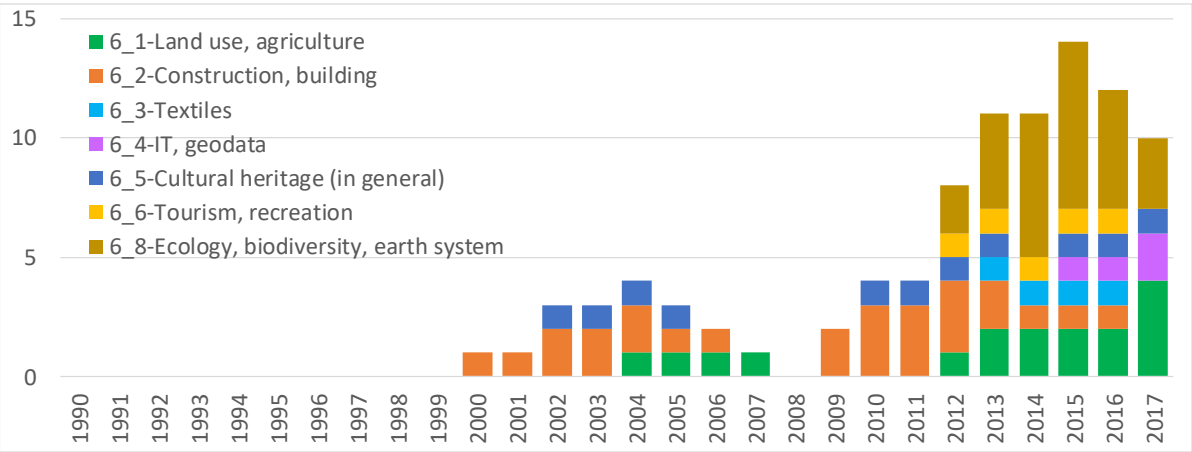
The dominance of wood materials and wood construction research is apparent. Since 2007 a further diversification of topics can be identified, starting with new projects addressing a broader scope i.e. cultural heritage or a focus on higher value added products i.e. furniture.

Fig. 8 Frequency of paper industry & biorefinery-related COST actions, 1990-2017



The paper industry and biorefinery-related actions (Fig. 17) show a peak of eight active actions in 2006 and 2007 with a gradual decline to only two actions active in 2017. The time series indicates a clear shift of thematic fields from recycling and biotechnology-focused actions to emerging novel topics in biochemistry.

Fig. 9 Frequency of COST actions in other sectors with relevance for the FBS, 1990-2017



COST actions in other sectors, which are also of medium relevance for research in the forest-based sector, occurred for the first time only in 2000, and more significantly only after 2009 (Fig. 18). Since then, their number has increased significantly up to 14 active actions in 2015. Various topics have emerged. The largest group of actions since 2012 includes actions in the field of ecology and biodiversity, which are of some interest to the forest management domain.

3.2.5 COST as trigger for further RTD collaboration

COST actions typically also can lead to the formation of new project consortia under European funding schemes i.e. the Framework Programmes. While not all COST actions achieve this, the role of COST can be described as crucial to allow researchers (and especially young researchers) to build up their personal network to other researchers and institutions in Europe and on the international level.

A few examples for follow-up actions are evidenced in the available reports (see Table 4). A good share of the actions report one to two follow-up Horizon 2020 projects, in which team members of the COST actions became participants. Besides, also a number of unsuccessful proposals to EC funding programmes are reported (between one to five per action).

Table 4 Examples of COST actions leading to follow-up RDTI actions

COST No.	*Action Acronym*		*New Action Acronym*	*Funding Programme*
FP1004	-	>	FP1402	COST
FP1006	-	>	BIOCOPOL	ERA-WWN3
FP1101	-	>	FP1402	COST
FP1201	FACESMAP	>	CLIMTREE	EU-Belmont
FP1201	FACESMAP	>	WINDRISK	EU-COFORD
FP1201	FACESMAP	>	Foret Pro bos	ERDF-INTERREG
FP1202	MaP-FGR	>	Gentree	H2020
FP1203	NWFPs	>	INCREDible	RUR
FP1205	-	>	NeoCel	H2020
FP1205	-	>	Trash-2-Cash	H2020
FP1206	EUMIXFOR	>	REFORM	ERA
FP1207	ORCHESTRA	>	DIABOLO	H2020

3.3 Outlook

The COST Actions have contributed to secure high-level research and innovation in Europe for the forest-based sector. It should be encouraged to inspire manifold new COST Actions in up-coming and emerging research fields of high importance to enlarge the knowledge-base and expertise within the European forest-based sector.

Some themes of high relevance have already been compiled in a database, e.g. 'The European Hardwoods Innovation Alliance –EHIA', under the umbrella of InnovaWood in collaboration with EFI. It will be used to facilitate the building of consortia for new COST ACTION proposals.

Special efforts should encourage more cooperation with research and development themes from other disciplines, like ICT, socio-economic, machinery, design, etc.

4. REFERENCES

4.1 Reports and data sources

WoodWisdom-Net. www.woodwisdom.net

PLATFORM of Bioeconomy ERA-NET Actions. www.era-platform.eu

SUMFOREST. www.sumforest.org

FORESTERRA. www.foresterra.eu

BiodivERsA. www.biodiversa.org

COST action database. www.cost.eu/COST_Actions/all_actions

Further access to additional internal sources was kindly provided by the COST office in Brussels (Elke Dall, Elwin Reimink).

4.2 List of experts

Andreas Kleinschmit von Lengefeld, Director Innovation, Research and International; Frédéric Rouger, Director Research; Mr. Alain Bouvet, Senior Statistics Analysist; FCBA Institut Technologique, France

Uwe Kies, Secretary General, InnovaWood asbl, Belgium

Mika Kallio, ForestValue Coordinator, Ministry of Agriculture and Forestry, Finland

Martin Greimel, SUMFOREST Coord., Federal Ministry of Sustainability and Tourism, Austria

Jean-Luc Peyron, ECOFOR, France

Jean-Michel Carnus, INRA, France

The experts and the SWG interacted twice during two plenary meetings, which took place in June 2017 in Helsinki, Finland and in October 2017 in Barcelona, Spain, in connection with the SUMFOREST final conference.

4.3 List of identified ERA-Nets and COST actions

The following list includes the 296 identified ERA-Nets and COST actions of high to medium relevance to the forest-based sector, grouped according to their main thematic focus. The listed actions' acronyms or numbers contain active hyperlinks to related project websites and programme pages, which allow an easy navigation for the reader (Note that some older actions do no longer have active websites).

Thematic field	*ERA-Nets*	*COST actions*
1. Forestry		
1.1 Forest inventory, monitoring, Decision Support Systems (DSS), ITC	3DFORMOD, CoForChange, CoForTips, FutureBioEcon, INFORMED, INVENT, RegioPower, WoodApps, WOODVALUE, WW-IRIS	E21, E43, ENFORS, FORSYS, FP0603, PROFOUND, USEWOOD
1.2 Forest ecosystem services, ecology, including soils, water, landscapes	BeFoFu, CONNECT, FORWARD, GREENFUTUREFOREST, INVALUABLE, POLYFORES, SmallFOREST, SOILFOREUROPE, SOSTPRO, SPONFOREST, WOODNET	BioLink, CLIMO, EUROFOREX, FORMAN, FP0803, FR-NET, PESFOR-W, PROFOR, SENSFOR
1.3 Forest management, silviculture, forest growth, including genetics, climate change, resilience, pests, disturbances	AgroCop, ANOPLORISK I, BREDNet-SRC, BURSA, C-227, CREFF, EUCANET, FASTFORESTS, FIREMAN, FORCLIMIT, FOREXCLIM, ForRisk, HemiPop, IPSN, LinkTree, MEDWILDFIRELAB, POPsRNA, PREREAL, RATING-SRC, REFORCE, REFORM, Rejuvenate, RESIPATH, SERV-FORFIRE, SidaTim, TipTree, WOP, WOVEN	813, DIAROD, E16, E38, E42, E47, E52, ECHOES, EUMIXFOR, FP0701, FP0801, FP0903, FP0905, FP1301, FP1401, FP1403, FRAXBACK, Genosilva, MaP-FGR, PINESTRENGTH, STReESS
1.4 Forest policy, socioeconomics, urban, social forestry	URBANMYCOSERVE, W3B Wood Believe	C11, E12, E19, E3, E30, E39, E51, FACESMAP, FORREC, FP1204, ORCHESTRA
1.9 Other uses: NWFP, bioenergy	COOL, REALMed	FP0902, NWFPs
2. Wood Industry		
2.1 Wood anatomy, processing, materials, modification	BIOCOPOL, CreoSub, FibreSurf, HI-FRETECH, Improved Moisture, PEKID, VARMA, WoodExter, WoodFibre3D, WoodSens, WoTIM	508, CEMARE, E10, E13, E15, E18, E2, E20, E22, E31, E35, E37, E44, E49, E53, E8, FP0802, FP0904, FP1006, FP1105, ModWoodLife
2.2 Wood construction, building	Acuwood, BenchValue, DuraTB, ECO2, EU Hardwoods, FireInTimber, GRADEWOOD, HCLTP, LBTGC, leanWood, Silent Timber Build,	E24, E29, E34, E40, E5, E55, FP0702, FP1004, FP1101, FP1303, FP1402, FP1404, RESTORE

Thematic field	*ERA-Nets*	*COST actions*
	smartTES, TallFacades, TES-Energy Facade, Wood2New	
2.3 Furniture, interior, cultural heritage	WinFur	SHELD-ON, Wood Musick, WoodCultHer
2.4 Recycling, Cascade Use, End-of-Life	CaReWood, DEMOWOOD, CTPro	-
3. Paper Industry		
3. Fibres, packaging, printing, biotech, recycling	BioPack, ELMO, FUNFIREBIC, MouldPulp, PowerBonds, TunableFilms	ActInPak, E1, E11, E14, E17, E23, E26, E32, E36, E41, E46, E48, E54, FP1003, FP1005, FP1104, FP1205
4. Biorefineries, bioenergy, bio-based products		
4.1 Bioenergy, solid biomass fuel, biofuels, bio-oils, pyrolysis	BIOHEALTH, Biomass-CHP, CESBIC, COPECOM, FUTUREBIOTEC, KANE, LIGNOHTL, NPTLCT, Q-WOODCHIP, SCITOBICOM, WoodStoves2020	BIOETHANOL
4.2 Cellulose, polymers, wood compounds, platform chemicals, bioplastics	2GEnzymes, AEROWOOD, BIOFOAMBARK, Cell-Assembly, COMPAC, Convert-Si, COSEPA, CrossCat, DesignCell, EPOS, GREASE, HEMICELL, Lilo, OXYPOL, PINOBIO, PROBARK, ProLignin, PRONANOCELL, PShapes, PUBB, ReCell, ReWoBioRef, WOBAMA	868, BIOBIO, FP0901, FP1306, UBIOCHEM
5. Other sectors		
5.1 Ecology, biodiversity, earth system, climate research	BASIL, BEARCONNECT, Climigrate, COUP, CROSSLINK, EC21C, ENABLE, FFII, PEGaSus, TB Alpine Wildlife	ENRAM, ES1306, FA1306, HarmBio, KEYSOM, NETLAKE, TD1209
5.2 Land use, agriculture, rural development	3D-Mosaic, ALFAPRO, API-Tree, APMed, BIOGEA, BIO-INCROP, CN-MIP, DIGGING_DEEPER, ECODEAL, EcoOrchard, FarmLAND, FI-ORAMA, I-224, RETHINK, SustainFARM, TRUSTEE, WASSA	634, C12, C16, CA16209, CONVERGES, ES1104, EuroXanth, IFER, NeCoE-PCM, NORM4BUILDING, SMIRES, SUPER-B, TU0901
5.3 Miscellaneous themes, incl. construction, textiles, recreation, health, geodata, new materials, cities	ALLERGOTYPE, AQUACLEW, BIOVEINS, CLISWELN, CO2CHEM, IMAGINE, INNOMED, URBANGAIA, URBES	BIG-SKY-EARTH, C17, CA16219, i2MHB, IS0904, TObeWELL, TU1303

Kleinschmit von Lengefeld, Andreas & Kies, Uwe, 2018.
Assessment of ERA-Nets and COST actions in the EU forest-based sector.
SCAR CASA Study for SWG Forest. FCBA Institut Technologique & InnovaWood.

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