Success stories

Projects funded under the 3rd ERA-NET BIOENERGY JOINT CALL

Short Rotation Coppice

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a source of cleaner, more secure and
sustainable energy for Europe

Foreword

Following the pilot joint call in 2006, the ERA-NET Bioenergy has continued to provide researchers with the opportunity to cooperate with their peers in other European countries on defined bioenergy topics in transnational, medium-sized project consortia. Up to today (summer 2012), we have published six joint calls for R&D proposals.

The third of these, on Short Rotation Coppice, was published in January 2008. The most innovative of the proposals we received were granted funding through the national agencies in the autumn of that same year.

The projects finished their work in early 2012, and from the abstracts published in this call brochure, it is evident that the 3rd ERA-NET Bioenergy joint call succeeded in establishing and developing cross-border R&D partnerships, and thus contributed to building a true European Research Area in the field of bioenergy.

We are already looking forward to the next action and as always invite the European R&D community to contribute.

ERA-NET Bioenergy

Introduction

A sustainable energy and resource supply is crucial for our society, now and in the future. A major transition will be required to shift from the existing fossil fuel based society to a more renewable resource based one. Several initiatives on a political level, such as the Renewable Energy Directive 2009/28/EC with the 20% goals for 2020, and the communication on the bioeconomy, COM(2012)60 show that we are all aware of this need, and the first steps for implementation will be taken. Innovation and further research and development are crucial to improve the market place and sustainability of bioenergy. This requires close collaboration on a European level.

It is in this respect of European collaboration that ERA-NET Bioenergy has offered support over the last years. In the new European Strategic Energy Technology Plan (SET-Plan), the European Commission adopts a transnational approach for jointly developing technologies and implementing them. The European Industrial Bioenergy Initiative has developed seven value chains in which demonstration projects will enable a position for bioenergy in the future. Together, the European Energy Research Alliance, ERA-NET Bioenergy and the ERANET+ project BESTF can be seen as tools on the funding side to further developing this European Research Area in bioenergy. Especially in a time of economic crisis with limited budgets, cost-effective research and development are crucial, and through European collaboration in ERA-NET Bioenergy pool resources and thus achieve a higher cost-effectiveness.

Results up until now have shown that cooperation on the funding side is possible, and that budgets from national programmes can be used to finance collaborative European projects. Admittedly our work remains a challenge: it is often difficult to combine national instruments and budgets to 'Joint Calls'. Policies and perceptions on bioenergy from different countries continue to vary.

However, collaboration is needed to create a sustainable and prosperous Europe. ERA-NET Bioenergy has the capacity to serve as a platform in Europe to create this collaboration.

The results from this joint call would not have been possible without all the hard work carried out by our colleagues from the partnering agencies. Their skills and endurance have been the key to success and have also created a platform of cooperation for years to come. ERA-NET Bioenergy is ready and available to support the national programmes in the future, based on national funding of the cooperation.

Coordinators of ERA-NET Bioenergy

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NL Agency, the Netherlands
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ERA-NET Bioenergy

ERA-NET Bioenergy's mission is to enhance the quality and cost-effectiveness of European bioenergy research programmes, through coordination and cooperation between EU Member States.

About ERA-NET Bioenergy
Pulling bioenergy research together

What is ERA-NET Bioenergy?
ERA-NET Bioenergy is a European network devoted to a structured cooperation of Member State national agencies and Ministries, responsible for coordinating and funding national research efforts in bioenergy. Collaborative research efforts not only lead to higher quality, but also to cost-effective results, contributing to a greener and more secure energy infrastructure, thus preserving valuable fossil fuels for generations to come.

The European strategy for renewable energy resources identifies bioenergy as the most important renewable energy source for the future – a source of cleaner, more secure and sustainable energy for Europe. Bioenergy is a highly diverse area: crops are converted to biofuels for transport; agricultural residues are converted to biogas and forestry residues or municipal waste are used to produce electricity and heat.

Driven by the potential benefits of bioenergy, and guided by the renewable energy targets, there are many national and regional bioenergy research programmes running in Europe. In 2007, the total R&D investment in bioenergy for the EU Member States reached €245 million[1]. A major part of this investment comes from the ten Member States which form the ERA-NET Bioenergy network.

Goal
The goal of ERA-NET Bioenergy is to strengthen national bioenergy research programmes through enhancing cooperation and coordination between national agencies. Through collaboration, the individual national programmes aim to produce higher quality results, while through coordination, they seek to complement each other, avoiding duplication.
To achieve these goals a structure for the systematic exchange of information has been set up and a number of joint actions, workshops and joint calls have been launched.

Main Stakeholders
The ERA-NET Bioenergy consortium consists of organisations that finance or manage national research activities with respect to bioenergy. These can be divided into:

- PROGRAMME OWNERS (financing the programme is located at Ministry level in most countries);

- PROGRAMME MANAGERS (governmental agencies or public bodies with similar mandates who manage the programmes. Most programme managers in the consortium are related to a "mother" Ministry, either directly (as an agency) or indirectly (as in a public or private body that manages a bioenergy programme on behalf of the government).

The involvement of all 3 elements (Ministries, agencies and programmes) is essential. If one of the basic elements is missing in any one country, it will have a major impact on possibilities to implement a joint programme. Without the involvement of the Ministries, there is no political commitment. Without the involvement of the agencies and programmes, there is no commitment with respect to content.

Although companies, research institutes and universities are not part of ERA-NET Bioenergy, their involvement is essential for the success of the coordination since they are the target groups of the RTD programmes involved.

[1] European Commission 2010: Strategic energy technology plan information system, http://setis.ec.europa.eu/mapping-overview/capacity-map/analyses/2009/report/results-on-biofuels, accessed 19.04.2010.

Introduction to the 3rd ERA-NET Bioenergy Joint Call

On 2nd January 2008, the third joint call for proposals was launched in the framework of ERA-NET Bioenergy. The topic of the call was "Short Rotation Coppice (woody species)".

The purpose of this call was to generate transnational, industrially relevant research and development activities on Short Rotation Coppice (SRC), to enhance European cooperation in this area and thus ultimately the quality of the research carried out. The main rationale behind the 3rd ERA-NET Bioenergy call links to the European Commission actively supporting the use of biomass for energy as part of its target of 20% CO2 emission reduction and 20% renewable energy by the year 2020. As a consequence, the demand for wood, traditionally the major raw material for bioenergy, is expected to rise.

By-products from conventional forestry have been the conventional woody biomass feedstock. However, the increasing demand raises concerns about future feedstock availability and its effects on conventional forest industry, as well as on wider environmental and social impacts. SRC (defined as short rotation coppice of woody species such as willow or poplar) is regarded as a promising option to mitigate these challenges. Although the species used for SRC may have a long commercial and scientific history, their application in the SRC concept is relatively new and requires further development especially with a view to becoming something more than a niche market.

Organisations from four ERA-NET Bioenergy countries participated in this joint call: ADEME from France, FNR from Germany, the Swedish Energy Agency from Sweden and BBSRC from the UK.

The Netherlands was not an official partner, however, NL Agency joined as an observer. TEKES from Finland agreed to moderate the jury discussions and therefore took part in the jury meeting and its planning. The BMVIT/FFG from Austria took an active part in the planning of the call and intended to participate, but in the end were prevented from doing so by national administrative difficulties.

The call topics were based on an ERA-NET Bioenergy workshop which included both national researchers and funding organisations. It was decided to invite proposals in three narrowly defined sub-topics:

1 **Genetic improvement of Salix and other woody SRC species ;**
2 **Improving the value chain of SRC;**
3 **Environmental aspects of SRC.**

The joint call was published on 2nd January 2008.

As a result of the call, three international project consortia could start their research work in September/October 2008 with partners from altogether five countries.

These consortia were:

CREFF:
Cost reduction and efficiency improvement of short rotation coppice on small field sizes and under unfavourable site conditions (Topic 2, France/Germany[/Austria][1])

BREDNet:
Targeted breeding of a European SRC willow crop for diverse environments and future climates (Topic 1, UK/Sweden)

RATING-SRC:
Reducing environmental impacts of SRC through evidence-based integrated decision support tools
(Topic 3, Sweden/Germany[/UK][2])

On 9th September 2008, a kick-off meeting took place in Potsdam, Germany.
The goals of the meeting were to:

- give researchers a chance to introduce their consortium and present their proposed research;
- clarify any administrative issues;
- provide the ERA-NET Bioenergy partners with feedback on the call and its procedures;
- provide an opportunity for networking.

On 7th February 2012, the three projects – which ended in that month – presented their final results in a seminar.

The complete event (7./8. February) was conducted jointly by ERA-NET Bioenergy and WoodWisdom-Net and comprised the final seminar of the SRC call (3rd ERA-NET Bioenergy Joint Call), the mid-term seminar of the 2nd WoodWisdom-Net call and the kick-off seminar of the joint call implemented jointly by ERA-NET Bioenergy and WoodWisdom (5th call of ERA-NET Bioenergy, 3rd of WoodWisdom-Net).

The event thus gave researchers the opportunity to present their successful research to a wider audience not only in the narrow topic of SRC, but the related areas of wood material use, forestry incl. socio-economics, and biorefinieries/biofuels.

[1] an Austrian industrial partner participated without public funding

[2] the UK partners could not be funded by BBSRC, but through alternative sources

RATING-SRC

Reducing environmental impacts of Short Rotation Coppice (SRC) through evidence-based integrated decision support tools

RATING-SRC is an ERA-NET Bioenergy project dealing with the impact of SRC of willow and poplar on the environment. The partners involved were from Germany and Sweden: The Swedish University of Agricultural Sciences (SLU), who coordinated the project, Chalmers University of Technology, Johann Heinrich von Thünen-Institut (vTI) in co-operation with Göttingen Soil Initiative (GBI e.V.); University of Göttingen, Dep. of Soil Science of Temperate and Boreal Ecosystems (PGZ); Bureau for Applied Landscape Ecology and Scenario Analysis, Göttingen (BALSA), University of Rostock and Beckmann Institute for Bio-production technology lines e.V. (BIOP Institute). Other general information for the project can be found at: http://www.ratingsrc.eu/.

SRC with willow and poplar is an agricultural crop for production of biomass for heat and/or electricity. A rapid increase of agricultural land cultivated with SRC has been projected in the short-term in several European countries. As a perennial crop, SRC differs from arable crops in physical traits and management practices, and a large-scale shift from "conventional" arable crops to SRC will have implications on a range of environmental issues. Research conducted within RATING-SRC provided scientific evidence to evaluate the impact (positive and negative) of SRC on soil, water and biodiversity, and also proposed ways to mitigate the negative and enhance the positive impacts.

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Field experiments were conducted in commercial SRC plantations in Sweden and Germany and all above-mentioned factors were investigated in a common way. Concerning phytodiversity, vegetation composition in 15 SRC plantations (willow, poplar) and in adjacent land-use units (grasslands and also forests) were investigated. The main findings suggest that SRC has positive effects on phytodiversity compared to arable land in terms of species number and diversity, and that in particular in regions with dominating arable land use SRC can positively contribute to landscape species diversity of vascular plants (diversity).

Zoodiversity studies in two SRC plantations (poplar) and in adjacent arable land were conducted looking at avian fauna and ground beetle assemblages. The total number of breeding birds was increased in SRC compared to adjacent land uses, and SRC were proved poor in species diversity and in abundance for specialized bird species and ground beetles. Structural diversity was found to promote faunistic diversity. For the impact on soil, studies on carbon and trace elements (16 commercial willow SRC plantations in Sweden) and for organic composition and microbial community (willow and poplar SRC in Germany and Sweden) showed that C storage and soil organic stability are higher in SRC and support C sequestration in the soil, and that Cd concentrations in the soil are significantly lower in SRC than in common arable crops. Groundwater quality (NO_3-N and PO_4-P) was also investigated in these willow fields; NO_3-N leaching to groundwater is substantially lower from SRC than from arable crops, but leaching of PO_4-P is not. In all, leaching of PO_4-P and Cd in soil of SRC were not affected by sewage sludge applications. Groundwater recharge studies suggested that recharge decreases when SRC replaces grassland, but such effects are not significant in catchment level.

Based on the above results concerning the impact of SRC establishment on the environment, a series of general recommendations to optimize SRC practice, achieving sustainable management while aiming at highest biomass production, were developed (the most important are presented below):

- **Establish SRC in homogenous arable landscapes to achieve highest positive effects on phytodiversity;**
- **Variable SRC structures (shoot age, species/clones, area shape) and habitat diversity (intensive land use mixtures) to increase ecotone area and thus biodiversity (phyto- and zoodiversity);**
- **Cultivate SRC in fields located close to N sources (animal farms, wastewater treatment plants etc) to decrease N outflow to adjacent water bodies;**
- **Establish SRC on fields with initial low C and high Cd soil concentrations to improve soil quality;**
- **Harvest more frequently and cultivate SRC for at least 3 cutting cycles to achieve the above;**
- **Recycle nutrients via municipal waste residues (no effect on groundwater and soil quality).**

CREFF Project

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Besides the large potentials and opportunities, the establishment and cultivation of SRC is also faced with several constraints and barriers – especially in the economics of the plantations. While most of the research results available in the past have been obtained for medium to good sites and the presumptions of a large field size for the SRC-plantations, this project focuses on unfavorable sites and small field sizes at scattered locations.

The main objective was the successful implementation of cost-efficient and consumer-oriented SRC-value-chains in regions with unfavourable site conditions for SRC. The research project covered all process steps of the SRC-value chain and is structured in 5 work packages (WP):

WP1 **Cost optimization through an adapted matching between plant material characteristics, site conditions and plantation management;**

WP2 **Improvement of harvesting systems and transport logistics with regard to specific site conditions (steep slopes, long rotation periods with large stem-diameters);**

WP3 **Value added conditioning of SRC raw material (regarding end product key-properties, industrial experiences, pilot storage trails and storage simulation device design);**

WP4 **The economics of SRC-value chains and optimization strategies with respect to site location and dimension.;**

WP5 **New business concepts for successful implementation of a product-oriented wood fuel value chain from SRC.**

The development of strategies allowing a major cost reduction and a higher efficiency have been achieved by an innovative approach to initializing intensive and early cooperation between producers and consumers. Within these cooperations, the SRC-production concentrated on the requirements of industrial consumers. Based on the known value chain structures all major processes like the production (species-site matching, spacing, rotation), harvest, logistics and conditioning of SRC-products were streamlined.

The Consortium work highlighted that farmers in the project region see SRC plantations as a good option to valorize their most marginal sites, where there is currently no or lower profit. However, the results have shown that SRC is not an option, which can raise profits on these unfavorable or marginal sites, but has the advantage to offer income with a minimum of input. The CREFF consortium has made a number of recommendations, based on the results of each work package in order to optimize the management of the plantation as a whole: Producer – consumer cooperations, products, plantation design, plant material, fertilization, harvest and logistic, fuel quality and conditioning methods.

Moreover, some tools have been developed by partners to help stakeholders in decision making. A technical guide (in French) has been developed for interested farmers to explain every step of a SRC plantation. Also an excel model, the "KUP Ernteplaner" (in German) was realised in order to allow farmers with a SRC to accurately plan their harvesting operations and related logistics.

The **BREDNET-SRC** consortium: association mapping in short rotation coppice willow (Salix viminalis)

Short Rotation Coppice (SRC) willow (genus Salix) is amongst the most advanced second generation energy crops in temperate regions due to its potential for high biomass yields in short timeframes, an ability to re-sprout after multiple harvests, simple and low cost propagation and a broad genetic base.

The over-arching aim of this project is to raise the efficiency and improve the delivery of public research supporting the genetic improvement of Short Rotation Coppice willow for wider environments and future climates. The research is designed to deliver maximum additive output within the context of the resources available and will build upon long-standing national research programmes that underpin the genetic improvement of willow as a bioenergy crop.

A key factor for success in crop improvement is a fundamental understanding of the different elements and interactions contributing to a complex target trait such as biomass yield. Molecular-genetic and genomic approaches can be implemented to dissect the basis of complex traits at the genetic and molecular level. Furthermore, these approaches can provide understanding of the key interactions between genotype and environment.

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In this project we have applied association mapping techniques to a population of >360 unique Salix viminalis genotypes collated from several collections and natural stands across central Europe. We have established four fully replicated experimental plantations, two in England and two in Sweden which encompass differing climate and soil types. Assessments of yield indicators such as bud-burst, stem number, height and diameter and onset of senescence, have now been made over a number of seasons. Additionally a greenhouse drought experiment showed a genotype dependant response that suggests the potential to breed more drought tolerant S. viminalis cultivars.

The collection was screened with 38 heterogeneous microsatellite markers spanning the willow genome. Analysis of the resulting data indicates a significant population structure (N=4). A subset of genotypes were selected for a secondary experiment in which they were planted both on poor arid soil and a highly productive soil on the same farm. A transcriptomic analysis was then performed to identify genes that were differentially expressed in the two environments. Differentially expressed genes identified in this experiment, as well as ~150 other candidate genes from literature and QTL experiments were then re-sequenced in 24 diverse genotypes to identify natural gene variants. Of these, 1586 SNPs were selected for genotyping in the entire population using Golden-gate SNP genotyping assays. Preliminary analysis of results from the first assay comprising 135 genes has identified a number of SNPs that are linked to bud burst, shoot number and rust resistance traits. Further results are currently in the analysis pipeline.

This project has established four Salix viminalis field trials in diverse geographic locations. These have been genotyped to assess their molecular diversity and a broad range of yield related phenotype measurements taken over the course of a full growth – harvest cycle. The phenotypic data accumulated as well as the sample material itself are important resources both for continuing analysis at the molecular and field level as well as for plant breeding. Similarly, the sequence and genotype data contribute to a database of several thousand genetic markers, a number of which have now been linked to yield related traits. This will improve our understanding of key complex traits and direct our plant breeding efforts towards the attainment of high biomass yield in this environmentally adaptable and economically viable bioenergy crop.

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