CenBio Bioenergy Innovation Centre

The scheme of the Centres for Environment-friendly Energy Research (FME) seeks to develop expertise and promote innovation through focus on long-term research in selected areas of environment-friendly energy, transport and CO_2 management in close cooperation between prominent research communities and users.

Acronym:
CenBio

Centre name:
Bioenergy Innovation Centre

Start date of centre: 2009-03-01
Duration: 8 years

D0.1.4_1
Annual report 2009

Revision: Final

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SINTEF Energi AS

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Dissemination Level		
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CO	Confidential, only for partners of the consortium	

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Deliverable title:	Annual report 2009
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	Article (popular science)
	Conference paper (published)
	Conference presentation (incl posters)
	Media Contribution (e.g feature article, interview, participation in radio/TV programme)
	Technical Report
	Chapter in book
	Book (PhD-dissertations, monographs)
	Post doc report
	Master report
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Author(s)		
Name	**Organisation**	**E-mail**
	Input from partners/WP- and SP leaders	
Einar Jordanger	SINTEF-ER	Einar.JORDANGER@sintef.no

Abstract

The Annual Report contains a brief description of the vision and objectives of the centre, and an extraction from the Annual Work Plan for the relevant calendar year. The organisation of the centre is presented, and the activities in the centre during the past year. In the appendices lists of personnel and publications, and a summary of the accounts are presented.

The official start date of CenBio is 1 March 2009. The first months was characterized by establishing the contractual documents required, by agreeing the management structure and working methods, and by making more specific plans for the first year. The initialisation of the technical activities started in parallel, and a separate application for specified laboratory infrastructure was accepted by the Research Council of Norway. Towards the end of 2009 some of the activities performed during the year were documented in some deliverables. Details of achievements can be found in this report.

Revision history			
Date	**Revision**	**Author(s)**	**Comments**
2010-04-09	Draft	Einar Jordanger	Sent CMT and RCN for comments
2010-04-16	Final	Einar Jordanger	Final version

Preface

CenBio – the Bioenergy Innovation Centre - is one of the eight Norwegian Centres for Environment-friendly Energy Research (in Norwegian: FME - Forskningssentre for miljøvennlig energi).

The centre is co-funded by the Research Council of Norway, a number of industrial partners and the participating research institutions.

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1 VISION AND GOAL

The vision of CenBio is to develop the basis for a sustainable, cost-effective bioenergy industry in Norway in order to achieve the national goal of doubling bioenergy use by 2020.

CenBio will address the entire value chains of virgin biomass and biodegradable waste fractions, including their production, harvesting and transportation, their conversion to heat, power and biogas, and the handling and upgrade of residues to valuable products. CenBio researchers will develop effective, environmentally sound ways of utilizing more biomass and waste for energy purposes. Educating and training the next generation of bioenergy researchers and industry players are essential to attain these ambitious goals.

As a result of the centre's activities, consumers will get access to different forms of environment-friendly energy, and society will be supplied with more renewable and CO_2-neutral energy. A further benefit will be the establishment of a Norwegian bioenergy industry and therewith a substantial number of new jobs, especially in rural districts.

2 RESEARCH PLAN

2.1 CenBio description

The overall objectives and principal work plan are explained in the centre description prepared during the application phase. The original description is referred to in the R&D Agreement between RCN and the host institution UMB. More detailed plan for the shorter term research activities is required, and an Annual Work Plan is to be submitted for RCN approval at the latest by 1 December each year. The Annual Work Plans will have to be based on the initial and less decisive description but course of the research may have to be changed due to external conditions.

2.2 Annual Work Plan

Obviously the AWP2009 could not be produced before 1 December 2008; and also the deadline for AWP2010 was deferred until 1 February 2010.

2.2.1 AWP2009

The original centre description was discussed at the kick-off meeting 15 May 2009 at Ås with partners attending. The AWP2009 was available as a working document shortly after the kick-off meeting. A draft version was presented at the first Executive Board meeting in Trondheim 17 June, and the first version was sent to EB for approval shortly after the summer holiday period, on 26 August.

A new revision, Rev.1, with more realistic ambitions and budget was presented for EB approval at its meeting at Ås 25 November.

2.2.2 AWP2010

The planning of research activities for 2010 started 22 October when CMT met physically in Trondheim. All partners were invited to attend a work plan workshop at Ås 26 November, and input from those discussions were used to produce the draft AWP2010 that was presented for EB approval at its meeting in Sarpsborg 13 January 2010. Some formal requirements from RCN had to be implemented, and on 18 March it was approved by RCN.

Deadline for submission of AWP2011 to RCN is 1 December 2010.

3 ORGANISATION/COORDINATION

3.1 Partners

Initially there are 26 partners participating in CenBio. Universitetet for miljø- og biovitenskap (UMB) is the host institution and SINTEF Energi AS is the coordinating institution. The governance structure is further elaborated in section 3.2.

The R&D Agreement between the Research Council of Norway and the host institution refers to two main categories of partners: Research partners and Industry partners.

3.1.1 Research partners

Universitetet for miljø- og biovitenskap (Host institution)
SINTEF Energi AS (Coordinating institution)
Norges teknisk-naturvitenskapelige universitet NTNU
Bioforsk
Norsk institutt for skog og landskap
Stiftelsen SINTEF
Vattenfall Research and Development AB (Sweden)

3.1.2 Industrial partners

Akershus Energi AS
Norges Skogeierforbund
Agder Energi AS
NTE Holding AS
Hafslund ASA
Trondheim Energi Fjernvarme AS
Norske Skogindustrier ASA
Xynergo AS
Norsk Protein AS
Avfall Norge
Norges Bondelag
Oslo Kommune Energigjenvinningsetaten
Afval Energie Bedrijft (Netherlands)
Vattenfall AB, Heat Nordic (Sweden)
Energos AS
Cambi AS
Jøtul AS
BioNordic AS
Granit Kleber AS

A list of short names used for convenience is shown in Table 8-2.

3.2 Governance structure

The governance structure as defined in the Consortium Agreement is shown in Figure 3-1.

The General Assembly consist of one representative from all partners, and meets physically at least once a year. As mentioned before all persons registered as CenBio personnel have access to the CenBio eRoom where they have access to all documents produced and planned events.

The Executive Board consists of seven members, three from Research partners and four from Industry partners. The Coordinating organisation appoints the chairperson.

Table 3-1: Executive Board members 2009

Position	Name	Affiliation
Chairperson	Inge Gran (until 25 Nov) Mona J. Mølnvik	02 SINTEF-ER
EB Member (Research)	Ragnhild Solheim	01 UMB
EB member (Research)	Johan Hustad (until 25 Nov) Olav Bolland	03 NTNU
EB member (Industry)	Morten Fossum	13 STATKRAFT
EB member (Industry)	Fredrik Hellström (until 25 Nov) Rune Dirdal	17 AVFALLN
EB member (Industry)	Jon Iver Bakken	12 HAFSLUND
EB member (Industry)	Christian Ramberg	09 SKOGEIER

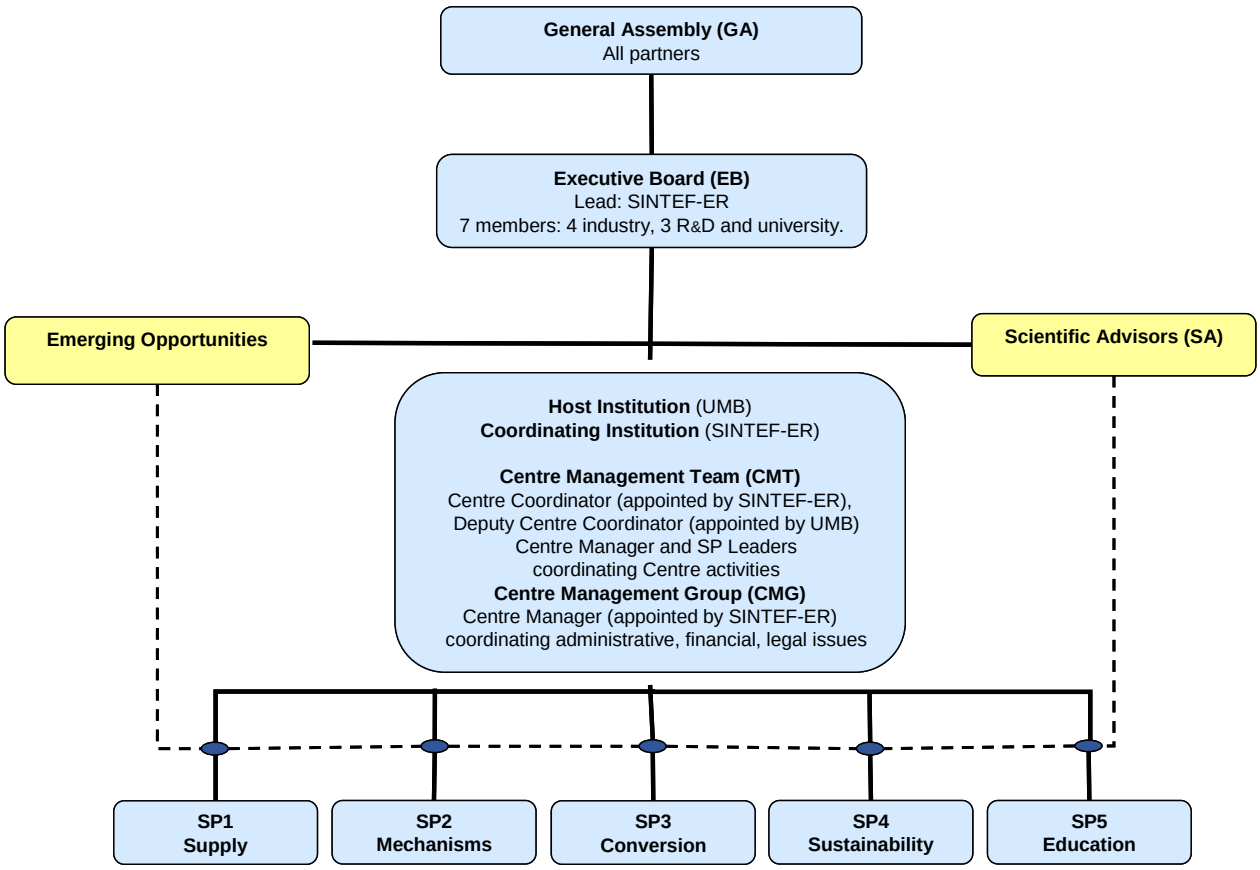

Figure 3-1: CenBio Governance Structure

The Centre Management Team (CMT) consists of the Centre Coordinator, the Deputy Centre Coordinator, the Centre Manager and the Sub-Project leaders. CMT is lead by the Centre

Coordinator. CMT arranges regular meetings as required for coordinating the activities in the Centre

Table 3-2: Centre Management Team

Position	Name	Affiliation
Centre Coordinator	Lars Sørum	02 SINTEF-ER
Deputy Centre Coordinator	Odd Jarle Skjelhaugen	01 UMB
Centre Manager	Einar Jordanger Michaël Becidan	02 SINTEF-ER 02 SINTEF-ER
SP1 leader	Simen Gjølsjø Hans Fredrik Hoen	05 NFLI 01 UMB
SP2 leader	Rainer Backman	02 SINTEF-ER
SP3 leader	Øyvind Skreiberg	02 SINTEF-ER
SP4 leader	Birger Solberg	01 UMB
SP5 leader	Anders H. Strømman	03 NTNU

3.3 Work Breakdown structure

The technical activities within CenBio are organised in five Sub Projects (SPs) which again is divided into three to four Work Packages (WPs). A separate WP is defined to separate the management activities from the technical work. The WBS is shown in Figure 3-2.

SP0: Management and Coordination
WP0.1 Management and Coordination
SP1: Biomass supply and residue utilization
WP1.1 Feedstock supply
WP1.2 Logistics
WP1.3 Biomass and residue characteristics and quality
WP1.4 Residues upgrading and use
SP2: Conversion mechanisms
WP2.1 Combustion
WP2.2 Gasification
WP2.3 Pyrolysis
WP2.4 Anaerobic Digestion
SP3: Conversion technologies and emissions
WP3.1 Wood / pellet stoves
WP3.2 District heat
WP3.3 Heat and power
WP3.4 Emissions
SP4: Sustainability analysis
WP4.1 Extended Life Cycle Assessment
WP4.2 Ecosystem management
WP4.3 Costs, markets, policies and integrated sustainability analyses
SP5: Knowledge Transfer and Innovation
WP5.1 Bio-Energy Graduate School
WP5.2 Knowledge transfer and dissemination
WP5.3 Innovation Management

Figure 3-2: Work Breakdown Structure

3.4 Management and Coordination

3.4.1 General

The overall coordination activities are organised within a separate work package, WP0.1 Management and Coordination. During 2009 the main activities have been to establish the contractual basement and working procedures, and to coordinate the planning of future research activities. Management within each SP is the responsibility of respective SP- and WP leader.

A project hotel has been established where all relevant documents are uploaded. Personnel from all partners have access to the CenBio eRoom. By 1 January 2010 approximately 120 persons had access to the eRoom. The overall structure of the eRoom is shown in Figure 3-3. The folder structure is shown to the left. Folder 050 Meetings and 02 EB meetings have been expanded to show three levels as an example. Also folder 100 SP1 Supply has been expanded to show the common structure for all SPs.

3.4.2 Meetings

All partners were invited to attend the kick-off meeting 15 May 2009 at Ås. On 26 November all partners were invited to participate in the planning of activities for 2010 as input for the Annual Work Plan 2010. And preparations for the first General Assembly meeting 14 January 2010 were initiated.

The Centre Management Team had four meetings in 2009, and the Executive Board had two.

Figure 3-3: CenBio eRoom structure

4 TECHNICAL ACTIVITIES

4.1 SP1 Biomass supply and residue utilization

4.1.1 WP1.1 Feedstock supply

WP1.1 has the responsibility of assessing and analyzing the current area and biomass availability, as well as analysing the long term production potential for biomass from forested areas for energy purposes. The activities follow two main lines of research;

i) Existing inventory methods of forest biomass, currently restricted to stem biomass, and
ii) The linkage between biological production and potential, silvicultural management, economic behaviour, sustainability criteria and biomass supply will be analysed by applying bio-economic optimisation models and econometric modelling.

Two reports are under preparation; D1.1.1 Assessing biomass availability – state of the art and D1.1.2 Current biomass availability in Norway.

4.1.2 WP1.2 Logistics

WP1.2 provides assessments and undertakes research to provide unit cost assessments for different forest operation systems and how these vary with growing stock and site characteristics. This includes the evaluation, calculation and comparison of alternative logistic chains for bioenergy supply.

D1.2.1 Road Map: defining the goals, roles and procedure for WP 1.2 is under preparation.

4.1.3 WP1.3 Biomass and residue characteristics and quality

WP1.3 analyses the variation among biomass fractions such as stem wood, branches, roots, bark, leaves and straw with focus on moisture content, calorific content, ash content, density, structure and chemical composition. WP1.3 also analyzes the impact of this variation on the practical fuel quality of new fuel fractions in their conversion to energy, to determine the level of upgrade or mixing these fuel fractions require to be converted to energy with high efficiency in low-costs installations.

An abstract is produced in D1.3.1 “Variations in Norwegian biomass properties end influences on bioenergy”. The paper will be presented on a conference in Trondheim in June.

4.1.4 WP1.4 Residues upgrading and use

WP1.4 provides research and analyse how the remaining residues when biomass is converted to energy may be best utilised and possibly recycled. This involves studies of upgrading, potential for use as input to produce fertilizers for plant production and removal of pollutants before use in e.g. building materials or in road fillings.

4.2 SP2 Conversion mechanisms

The research tasks in this subproject are related to feedstock requirements and technology implications for efficient use of new bioenergy fractions and mixtures.

Main focus is on the fundamental mechanisms for production of biogas and heat and power from biomass, organic waste and municipal solid waste. This includes the mechanisms involved in combustion (WP2.1), gasification (WP2.2), pyrolysis (WP2.3) and anaerobic digestion (WP2.4).

The key issues connected to these fundamental mechanisms are efficiencies with respect to energy yields, costs and raw materials utilization. Their feedstock implications with respect to fuel quality requirements and their technology implications with respect to emissions, flexibility, and operational reliability and robustness consequences are central.

The work in 2009 has been concentrated on development of the Bioenergy Laboratory in Trondheim as well as on state-of-the-art reports on experimental methods and modelling.

4.2.1 WP2.1 Combustion

A study on state-of-the art experimental methods for studies of fuel, fuel mixing and additives effects on corrosion, fouling, emissions and residues in combustion processes was started and will be finished by May 2010. This work is being followed up by an experimental study on additives and fuel mixtures for reduced corrosion and fouling.

An experimental study on NOx reduction by staged air combustion carried out in a multi-fuel reactor is carried out and will be finished by June 2010, see Figure 3-1. It will be followed up by a modelling study on NOx reduction by staged combustion which is finished by June 2011.

The Bioenergy Laboratory in Trondheim has been completed with new advanced analysis equipment. These include biomass feedstock analysis equipment (ICP-OES) Varian 720ES equipped with a microwave digestion system Milestone Ethos 1 and a gas analyzers (FTIR) Nicolet iS10 to determine composition of product gases from biomass combustion, gasification and pyrolysis. The development also include experimental devices for biomass particle reactivity in thermal processes (TGA, DSC), a fast heating rate TGA TA Instruments Q5000IR, a simultaneous TGA/DSC TA Instruments Q600, and a DSC with T-Zero features, TA Instruments Q2000. A new laboratory space for these devices has been built in the Thermal Laboratory in Trondheim.

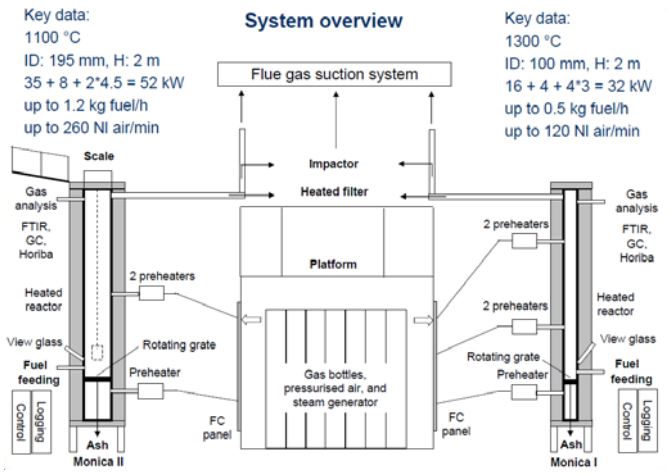

Figure 4-1: Multi fuel reactor setup

WP2.1 also includes participating in IEA Task 32, Biomass Combustion and Cofiring.

4.2.2 WP2.2 Gasification

4.2.3 WP2.3 Pyrolysis

The chemical modelling work on biomass and waste gasification and pyrolysis processes has started with a state-of-the-art study. A first version of an integrated pyrolysis-gasification process model is finalized. These studies are the basis for further model development, experimental work on biomass reactivity and process concept evaluations in 2010.

4.2.4 WP2.4 Anaerobic Digestion

Laboratory for anaerobic digestion has been designed at Ås. The development of the laboratory has started with a 6m3 biogas reactor and twenty new 6, 10 and 20 litres laboratory biogas reactors, see Figure 3-1Figure 4-2. The laboratory development will be finalized during 2010.

Figure 4-2: The Biogas laboratory at Ås

An MSc thesis work on anaerobic digestion has been accomplished.

4.3 SP3 Conversion technologies and emissions

SP3 objective: To demonstrate that all the energy conversion efficiencies listed in the CenBio Vision 2020 are practically and economically feasible, as well as environmentally benign.

Overall evaluation of progress:
Number of deliverables in 2009: 1
Number of deliverables started in 2009 and to be delivered in 2010: 8
Number of R&D partners involved: 2 (SINTEF Energy Research and Vattenfall R&D)
Management and cooperation evaluation: The SP management and activities have been established, and good progress has been made. Good research cooperation is established within SP3, with other CenBio SPs, and good industry involvement has been achieved. Three SP meetings have been arranged in 2009 to coordinate activities.

4.3.1 WP3.1 Wood / pellet stoves

A status for standards on wood- and pellet stoves and needed improvements has been made. Participating in standardization work is a continuous effort in WP3.1. Development of one concept for a new combustion chamber has been carried out and the concept is already in use for heat storing stoves. Initial experimental work on transient particle and gas emissions from wood

stoves has been carried out. More extensive experiments will be carried out in 2010, leading to a journal publication.

4.3.2 WP3.2 District heat

Three literature studies, for reporting in 2010, have been started: 1) A review on additives against fouling and corrosion, 2) A study on retrofit possibilities for increased electric efficiency and 3) A review on oxygen enhanced combustion. WP3.2 also includes participating in IEA Task 36, Integrating Energy Recovery into Solid Waste Management Systems.

4.3.3 WP3.3 Heat and power

A study on possibilities for cost-efficiency improvements in industrial biomass heating plants has been started, to be reported in 2010. Installation and start-up of the ChlorOut injection system for combined corrosion prevention and NOx removal at the Jordbro CHP plant in Sweden has been started. A KMB KRAV seminar on CHP technologies in a Norwegian perspective (open for CenBio partners) has been arranged.

4.3.4 WP3.4 Emissions

A literature survey on NOx precursors release and available models has been started, to be reported in 2010. An initial work connected to a planned continuous effort on mapping of emissions from Biomass to Energy (BtE) plants has been started, to be reported in 2010. This work will be followed up, leading to an extensive and well planned experimental campaign at a selected plant.

The work carried out in CenBio SP3 in 2009 has mainly been concerned with literature/review studies and initial experimental work and analysis studies, to be reported in 2010. The results of these review and initial studies will pave the way for fundamental and applied research connected to various conversion technologies with respect to emission reduction and increased cost-efficiency.

4.4 SP4 Sustainability analysis

This SP has as main objectives to perform sustainability analyses of the main bioenergy technologies investigated/developed in SP1, SP2 and SP3, based on the three pillars for sustainability: environmental, social and economic factors.

4.4.1 WP4.1 Extended Life Cycle Assessment

Research activities got started according to plan late in Q4 of 2009. The late start was mainly due to time required for recruiting personnel. Geoffrey Guest, PhD student was the first to join the team. He started in time for the fall semester. However, he was mainly occupied with taking courses in 2009. Francesco Cherubini, post.doc started in October and Ottar Michelsen, researcher, started in November 2009. Ottar Michelsen was however mainly occupied with activities in the bioenergy graduate school in 2009. Francesco has been the main researcher on deliverable D4.1.1 State of the Field – work is in progress power point presentation. This deliverable was met as well as all milestones.

4.4.2 WP4.2 Ecosystem management

In collaboration with two other projects, post-harvest data were collected from Gaupen experimental plot, where short-term ecosystem processes are being studied after two different

harvest regimes, conventional harvesting and above-ground whole-tree harvesting. A poster entitled “Effects of increased biomass removal on the biogeochemistry of two Norwegian forest ecosystems” was presented at the Biogeomon conference (dealing with biogeochemical cycles) in Helsinki on 29 June-3 July 2009, and at a workshop organised by IEA Bioenergy Task 31 (“Biomass Production for Energy from Sustainable Forestry”) at Wershofen, Germany, on 5-8 October 2009.A PhD student, Silje Skår, was appointed to work on ecological modelling related to increased biomass removal in forests in Norway.

4.4.3 WP4.3 Costs, markets, policies and integrated sustainability analyses

In 2009 work was started on improving the NTM II and EFI-GTM models and applying them for analyses of national and international timber supply issues – in particular impacts on the competition for wood biomass in Norway of increased bioenergy prices, analyses of effects and costs of selected policies to increase bioenergy use and reduce GHG emissions from heating in Norway, and the international timber supply/demand impacts of increased Russian export tariffs and regulations of illegal logging. The WP leader participated in one meeting in the project EU-Bionet and in two meetings in the IEA Task 40 (International trade of biomass). WP4.3 has finances for only one research position, and we were able of recruiting a senior researcher (Dr. A. Moiseyev) who will start working in CenBio medio April 2010, but could participate in some of the above mentioned works in 2009. Most of the work in 2009 in WP4.3 has therefore been done in collaboration with other projects and by using permanent employed persons at UMB/INA.

4.5 SP5 Knowledge Transfer and Innovation

The work in SP 5 has got off to a slow but good start. Important milestones met are the planning of a joint course on bio energy provided by UMD and NTNU in collaboration. Further the establishment of external communication channels via the web page and news letter. We expect more momentum on the innovation work as the pace on the base research also increases.

4.5.1 WP5.1 Bio-Energy Graduate School

The activities in WP5.1 have primarily been start-up activities. A coordinator (M5.1.1) is recruited, who also has taken over the responsibility as WP leader. A preliminary plan for the bioenergy graduate school (D5.1.1) is developed. A final version will be made during spring 2010.

Of important activities in addition, has been the development of a new master course in bioenergy, which will be run as a collaboration between UMB and NTNU for the first time fall 2010. A database on PhD students and Post docs working on issues in relation to CenBio is initiated, and the first gathering for these was planned in 2009 and held in January 2010.

4.5.2 WP5.2 Knowledge transfer and dissemination

The activity within knowledge transfer and dissemination has been high in 2009. The status of the planned deliverables (D) and milestones (M) are:

- D5.2.1: Mobility activities between academia and industry have been included in AWP 2010, and two industry partners have signed up as hosts for PhD- or Master students.
- D5.2.2: A CenBio web-site was established June 2009 and has been in operation since then. The site will be more dynamic in 2010.
- D5.2.3: The first CenBio newsletter has been produced; the theme was Research findings and status. Production of the second newsletter, about Innovations and how the industry partners plan to utilize them, has been started. It will be completed in 2010.

- D5.2.4: The first annual CenBio conference including EB, CMT, GA, workshops and a gathering for PhD-students in the bioenergy field has been planned. It was conducted as a 2-days event January 13-14, 2010, hosted by one of the industry partners, Hafslund ASA. The number of participants was about 50, plus 20 PhD-students.
- D5.2.5: In total 9 pop-tech and newspaper articles have been published, of which 4 in the web-site "forskning.no". They are all uploaded in CenBio eRoom. In addition, the centre coordinators have presented CenBio at several conferences.
- M5.2.3: More than 10 scientific articles have been planned and included in AWP 2010.

4.5.3 WP5.3 Innovation Management

In 2009 the work in task 5.3.4 was started. Several applications for projects relevant to CenBio were sent to NFR in 2009 in order to extend and complement existing tasks. Two KMB-applications were accepted and will start up in 2010:

- "STOP - STable OPerating conditions for biomass and biomass residues combustion Plants", Research partners: SINTEF, NTNU
- "GasBio - Gasification for Biofuels", Research partners: SINTEF, NTNU

Another proposal, a co-operation between SINTEF ER, SINTEF MC, Bioforsk and ScanBio Bjugn AS, was not accepted (MarBio).

The other tasks will start up in 2010.

5 INTERNATIONAL COOPERATION

5.1 EU co-funded projects

5.1.1 NextGenBioWaste

NextGenBioWaste is a four year EU co-funded project that started in February 2006. The full title "Innovative demonstrations for the next generation of biomass and waste combustion plants for energy recovery and renewable electricity production" indicates the main issues addressed in the project. In addition to the technical achievements obtained during the four year cooperation the networking aspect was of great value.

SINTEF Energi AS was the Coordinator of the project with 17 partners from seven European countries as illustrated in Figure 5-1.

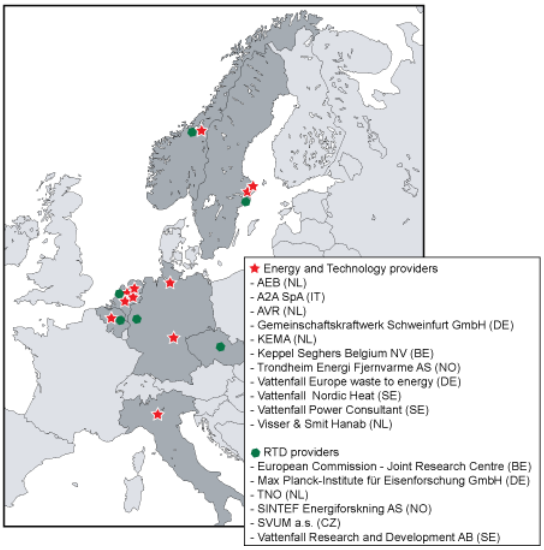

Figure 5-1: Partners in NextGenBioWaste

5.2 International organisations

In Table 5-1 the various tasks within IEA Bioenergy where CenBio personnel are involved are listed.

Table 5-1: Participation in IEA Bioenergy activities

IEA Bioenergy Task No	Task title	Task member WP No	Representative
Task 32	Biomass Combustion and Co-firing	02 SINTEF-ER WP2.1	Øyvind Skreiberg
Task 33	Thermal Gasification of Biomass	02 SINTEF-ER WP2.2	Rainer Backman
Task 36	Integrating Energy Recovery into Solid Waste Management Systems	02 SINTEF-ER WP3.2	Michaël Becidan
Task 37	Energy from biogas and landfill gas	04 BIOFORSK WP2.4	Espen Govasmark
Task 40	Sustainable International Bioenergy Trade - Securing Supply and Demand	01 UMB WP4.3	Birger Solberg Erik Trømborg

5.3 International institutions

The institutions listed below were involved during the application phase of CenBio in 2008. During the first year of operation there has been little contact except on an individual basis with personnel from some of these institutions. In 2010 some scientific advisors for CenBio as illustrated in Figure 3-1 will be recruited from some of these institutions.

- Stanford University (USA)
- US Forest Service
- University of Minnesota (USA)
- Finnish Forest Research Institute
- Chalmers University of Technology (S)
- Abo Akademi University (SF)
- Technical University of Denmark
- University of Copenhagen (DK)
- Vienna University of Technology (A)
- Technical University Bergakademie Freiberg (D)

5.4 International conferences

CenBio has been presented at some international conferences in 2009.

Lars Sørum and Odd Jarle Skjelhaugen presented “Bioenergy Innovation Centre” at the Transatlantic Science Week, Minneapolis, USA, 28-30 September 2009.

Odd Jarle Skjelhaugen presented “Bioenergy Innovation Centre” at NEREC (North European Renewable Energy Congress), Lillestrøm, Norway, 6 October 2009.

6 DISSEMINATION

6.1 Website

The first version of the CenBio website was established and published in June 2009. Figure 6-1 show the front page as of 1 April 2010.

Figure 6-1: CenBio website

6.2 Deliverables

All results from both management and technical activities within CenBio are documented in Deliverables, whether they are public or for internal distribution only. The list presented in Table 8-3 shows the deliverables that were finalised in 2009.

The deliverables are numbered according to the WP to which it belongs with the third digit as a unique counter. One deliverable in a series of several planned deliverables is marked with a new counter as the fourth digit. The number for this report illustrates the numbering system: D0.1.4_1 where 0.1 refers to WP0.1, 4 is selected as the unique number for annual reports while the _1 means the first in a series; i.e. annual report for the first year of operation.

7 ACCOUNTS

A detailed accounts report for 2009 was submitted to RCN in January 2010. The main financial figures are repeated in this annual report.

7.1 Budget

Table 7-1 shows the anticipated overall budget for CenBio for eight years, as presented in the AWP2009. The total costs are estimated at NOK 271,680 million, distributed as given in the table.

The total funding from RCN is NOK 120 million for all four years, i.e. NOK 15 million per year. Since CenBio started 1 March 2009 the budget for 2009 was somewhat reduced compared to an average year. The cost budget for 2009 was NOK 30,193 and budgeted funding from RCN was NOK 13,336 million.

Table 7-1: CenBio overall budget (source: CenBio Annual Work Plan 2009)

		Budget								
mill. NOK	**Total**	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total	**271,680**	**30,193**	**33,960**	**33,960**	**33,960**	**33,960**	**33,960**	**33,960**	**33,960**	**3,767**

7.2 Accounts 2009

Total costs reported from the partners in 2009 amounts to NOK 27,7 million, of which NOK 22,8 million from Research partners and NOK 4,9 million from Industry partners. The main reason for the slow start from most Industry partners was that the Consortium Agreement was signed by the last partner late October and the R&D Agreement was signed in December.

The funding from RCN amounts to 48% of the total costs.

8 APPENDICES

8.1 Personnel

8.1.1 Key Researchers

Name	Sex	Affiliation	Topic/Research area	Funding	Duration
Odd Jarle Skjelhaugen	M	01 UMB	Coordination	CenBio	
Trond Eid	M	01 UMB	Feedstock supply	CenBio	
Øivind Løken	M	01 UMB	Feedstock supply	CenBio	
Hans Fredrik Hoen	M	01 UMB	Biomass supply and residue utilization	CenBio	
Olav Høibø	M	01 UMB	Biomass and residue characteristics	CenBio	
Birger Solberg	M	01 UMB	Sustainability analysis	CenBio	
Vincent Eijsink	M	01 UMB		CenBio	
Svein Jarle Horn	M	01 UMB		CenBio	
Lars Sørum	M	02 SINTEF-ER	Coordination	CenBio	
Einar Jordanger	M	02 SINTEF-ER	Coordination	CenBio	
Øyvind Skreiberg	M	02 SINTEF-ER	Conversion technologies	CenBio	
Rainer Backman	M	02 SINTEF-ER	Conversion mechanisms	CenBio	
Michael Becidan	M	02 SINTEF-ER	District heat	CenBio	
Edvard Karlsvik	M	02 SINTEF-ER	Wood- and pellet stoves	CenBio	
Roger Khalil	M	02 SINTEF-ER	Biomass and residue characteristics	CenBio	
Judit Sandquist	F	02 SINTEF-ER	Biomass and residue characteristics	CenBio	
A. Klenovcanova	F	02 SINTEF-ER	Conversion mechanisms	CenBio	
Granziska Goile	F	02 SINTEF-ER	Conversion technologies	CenBio	
Bjarne Malvik	M	02 SINTEF-ER	Conversion technologies	CenBio	
Mette Bugge	F	02 SINTEF-ER	Innovation Management	CenBio	
Anders Strømman	M	03 NTNU	Knowledge Transfer and Innovation	CenBio	
Johan E. Hustad	M	03 NTNU	Knowledge Transfer and Innovation	CenBio	
Ottar Michelsen	M	03 NTNU	Bio-Energy Graduate School	CenBio	
Trond Haraldsen	M	04 BIOFORSK	Residues upgrading and use	CenBio	
Roald Sørheim	M	04 BIOFORSK	Anaerobic Digestion	CenBio	
Tormod Briseid	M	04 BIOFORSK	Anaerobic Digestion	CenBio	
Roar Linjordet	M	04 BIOFORSK	Anaerobic Digestion	CenBio	
Mie Bjune	F	04 BIOFORSK	Anaerobic Digestion	CenBio	
Bruce Talbot	M	05 NFLI	Logistics	CenBio	
Anders Eid Hohle	M	05 NFLI	Biomass supply and residue utilization	CenBio	
Simen Gjølsjø	M	05 NFLI	Biomass supply and residue utilization	CenBio	
Kjell Vadla	M	05 NFLI	Biomass supply and residue utilization	CenBio	
Rasmus Astrup	M	05 NFLI	Biomass supply and residue utilization	CenBio	
Nicolas Clarke	M	05 NFLI	Ecosystem management	CenBio	
Geir Østreng	M	05 NFLI	Ecosystem management	CenBio	
Bjarte Arne Øye	M	06 SINTEF-MC	Residues upgrading and use	CenBio	
Lennart Gårdman	M	07 VRD	Heat and power	CenBio	

8.1.2 Visiting Researchers

Name	Sex	Affiliation	Topic/Research area	Funding	Duration

8.1.3 Postdoctoral researchers

Name	Sex	Affiliation	Topic/Research area	Funding	Duration
Francesco Cherubini	M	03 NTNU	LCA bioenergy systems	CenBio	
Edita Garskaite	F	01 UMB	Pyrolysis and solar cells		
Marit Lie	F	01 UMB	Bio diversity forest and sustainability		
Bjørge Westereng	M	01 UMB	Enzym processes		
Zehra Zengin		01 UMB	Biogas		

8.1.4 PhD students

A database on PhD students working on issues in relation to CenBio is established, see Table 8-1.

Table 8-1: PhD students, CenBio funded and associated (updated December 2009)

Name	Sex	Affiliation	Topic/Research area	Funding	Duration
Geoffrey Guest	M	03 NTNU	Hybrid life cycle analysis of solid bio-fuel systems	CenBio	2009-08 2012-09
Shaza Ayoub	F	01 UMB / Comsats	?		2007-10 ?
Ryan Bright	M	03 NTNU	LCA of Second Generation Biofuels		2008-09 2011-11
Shuling Chen		01 UMB	Bioenergimarkeder		?
Maria M. Estevez	F	01 UMB	Optimization of biogas production (From biomass to biogas project)		2009-12 2012-11
Kristian Fjørtoft	M	01 UMB	Biogas optimization in farm scale biogas plants		2009-08 ?
Zarah Forsberg	F	01 UMB	Characterization and directed evolution of carbohydrate-binding modules (CBMs) for biomass conversion		2010-01 2013-12
Espen Halvorsen	M	01 UMB	Matrix based decision support system for forest management ms	UMB	2008-11 2011-11
Per-Ivar Hanedalen	M	01 UMB	Life cycle assessment of bio energy based on raw materials from agricultural systems	UMB	2009-09 2013-01
Knut Marius Hauglin	M	01 UMB	Estimating forest biomass components using airborne laser scanning	UMB+ RCN	2008-12 2012
Ehsan Houshfar	M	03 NTNU	Experimental studies on two-stage combustion of biomass	KRAV	2009-03 2012-02
Dhandapani Kannan		03 NTNU	Study of Diesel Combustion and Emissions with Fischer-Tropsch (F-T) fuels and Bio fuels		2008-09 2011-09
Heidi Nygård	F	01 UMB	Pyrolysis of Biomass in Molten Salts		2009-06 2013-06
Kavitha Pathmanathan	F	03 NTNU	High Temperature Filtration of biomass combustion and gasification processes		2007-06 2011-06
Hanne K. Sjølie	F	01 UMB	Economic analyses of use of forest and wood products in Norway to reduce the atmospheric concentration of greenhouse gases (GHG)	UMB	2007-11 2011-06
Geir Skjervak	M	03 NTNU / Statoil	High Temperature Filtration of biomass combustion and gasification processes		?
Silje Skår	F	01 UMB	Ecological modelling related to increased biomass removal in forests in Norway		2009-12 2013-12
Dhruv Tapasvi		03 NTNU	Biomass gasification		2010
Clara Valente	F	01 UMB / HiHm	Impacts of woody biomass production for bioenergy purpose in mountainous areas: studies from Norway and Italy	NRC	2008-09 2011-11
Liang Wang	M	03 NTNU	Biomass gasification		2006-09 2010-06
Hong Zhai		01 UMB			2008-08 2011-07

8.1.5 Master degrees

Name	Sex	Affiliation	Topic/Research area	Funding	Duration

8.2 Accounts

8.2.1 Funding

Source	NOK million
The Research Council	13,336
Research partners	9,483
Industry partners	4,919
Public partners	0,000
Total	**27,738**

8.2.2 Costs

Source	NOK million
Research partners	22,579
Industry partners	4,919
Public partners	0,000
Equipment	0,240
Total	**27,738**

8.3 Publications

8.3.1 Journal Papers

Title	Author(s)	Journal

8.3.2 Published Conference Papers

Title	Author(s)	Conference

8.3.3 Books

Title	Author(s)

8.3.4 Reports

Title	Author(s)

8.4 List of partners – short names

For the same of convenience unique short names for all partners have been defined. These can be found in Table 8-2

Table 8-2: Short names of partners

No	Short name	Entity legal name
01	UMB	Universitetet for miljø- og biovitenskap (Host institution)
02	SINTER-ER	SINTEF Energi AS (Coordinating institution)
03	NTNU	Norges teknisk-naturvitenskapelige universitet NTNU
04	BIOFORSK	Bioforsk
05	NFLI	Norsk institutt for skog og landskap
06	SINTEF-MC	Stiftelsen SINTEF
07	VRD	Vattenfall Research and Development AB
08	AKERSHUS	Akershus Energi AS
09	SKOGEIER	Norges Skogeierforbund
10	AGDER	Agder Energi AS
11	NTE	NTE Holding AS
12	HAFSLUND	Hafslund ASA
13	STATKRAFT	Trondheim Energi Fjernvarme AS
14	NSKOG	Norske Skogindustrier ASA
15	XYNERGO	Xynergo AS
16	PROTEIN	Norsk Protein AS
17	AVFALLN	Avfall Norge
18	BONDELAG	Norges Bondelag
19	EGE	Oslo Kommune Energigjenvinningsetaten
20	AEB	Afval Energie Bedrijft
21	VHN	Vattenfall AB, Heat Nordic
22	ENERGOS	Energos AS
23	CAMBI	Cambi AS
24	JØTUL	Jøtul AS
25	BIONORDIC	BioNordic AS
26	GKAS	Granit Kleber AS

8.5 Deliverables list – Publications

In AWP2009 a total of 26 deliverables were planned to be finalised in 2009. All planned deliverables were initiated, however quite many were not finalised by 31 December. The table below shows that 15 deliverables had been finalised by the end of the year. During the first three months of 2010 almost all 2009 deliverables have been finalised.

Table 8-3: List of Deliverables finalized in 2009

Del. No	Deliverables title	Lead partner	Dated

Del. no.	Deliverable title	Lead partner	Dated
D0.1.0	Consortium Agreement / Management	**SINTEF-ER**	**2009-10-27**
D0.1.1_1	Annual Work Plan 2009	**SINTEF-ER**	**2009-08-26**
D0.1.1_1 rev1	Annual Work Plan 2009	**SINTEF-ER**	**2009-11-14**
D0.1.1_2	Annual Work Plan 2010	**SINTEF-ER**	**2009-12-22**
D0.1.2_12	Progress report 2 2009	**SINTEF-ER**	**2009-12-14**
D1.1.1	Assessing biomass availability - state of the art	**UMB**	**2009-12-28**
D1.1.5	PhD proposal (NLFI based) related to birch biomass to be approved at UMB	**NFLI**	delayed
D1.1.7	Potential future biomass availability in Norway (pop science article)	**UMB**	delayed
D1.2.1	Road Map: Defining the goals, roles and procedure for WP1.2	**NFLI**	**2009-12-04**
D1.2.2	Initial status report on unit costs and productivity estimates of relevant forest operation elements	**NFLI**	delayed
D1.2.3	Technical survey report: an overview of biomass production and delivery systems in a Norwegian context	**NFLI**	delayed
D2.1.4	Bioenergy laboratory development 2009	**SINTEF-ER**	**2010-01-11**
D2.4.1	Common laboratory designated anaerobic digestion at Campus Ås; first SOPs established	**BIOFORSK**	delayed
D2.4.2	Manuscript on bottlenecks of anaerobic digestion	**UMB**	delayed
D2.4.3	Documented overview on relevant raw materials, accessible amount and their characterisitics	**UMB**	delayed
D2.4.4	First anaerobic digestion MSc	**UMB**	delayed
D3.1.1	Status for standards on wood- and pellet stoves and needed improvements	**SINTEF-ER**	**2010-01-12**
D4.1.1	State of the Field - work in progress	**NTNU**	**2009-12-18**
D4.2.1	Poster describing the ecosystem studies (Biogeomon conference, Helsinki, 29 Jun-3 Jul)	**NFLI**	**2009-06-30**
D5.1.1	Plan for Bio-Energy Graduate School 2010-2012	**NTNU**	delayed
D5.2.1	2010-plans for mobility activities between academia and industry, for SP1-SP4	**All**	delayed
D5.2.2	CenBio web-site	**UMB**	**Continuous**
D5.2.3-1	CenBio newsletter No 1	**UMB**	**2009-12-22**
D5.2.3-2	CenBio newsletter No 2	**UMB**	delayed
D5.2.5-1	10 pop tech and newspaper articles	**All**	**done**
D5.3.5	Application activities 2009	**SINTEF-ER**	**October**

8.6 References

R&D Agreement between RCN and the host institution UMB
Consortium Agreement

Annual Work Plan 2009
The FME scheme (RCN website 2010-04-01)
Annual Work Plan 2010

CenBio website
RCN's FME-website, in Norwegian (in English)

