

# IEA Bioenergy

## TASK 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems

### END OF TASK REPORT

For the Period: 2001- 2003



CHP plant, Östersund, Sweden

## Summary

Interest in reducing emissions of greenhouse gases to the atmosphere is increasing, due to awareness of the risk of climate change, and due to the adoption of the Kyoto Protocol in 1997. Countries are beginning to implement programs that aim at limiting emissions of greenhouse gases. Bioenergy is an attractive option to pursue this goal as biomass can play a dual role in greenhouse gas mitigation related to the objectives of the UNFCCC, i.e. as an energy source to substitute for fossil fuels, and as a carbon reservoir. Modern bioenergy options offer significant, cost-effective and long-term opportunities towards meeting emission reduction targets. Moreover, via the sustainable use of the accumulated carbon, bioenergy has the potential for resolving some of the critical issues surrounding long-term maintenance of biotic carbon stocks. Finally, wood products can act as substitutes for more energy-intensive products, can constitute carbon sinks, and can be used as biofuels at the end of their lifetime.

In 2000 the Executive Committee of IEA Bioenergy approved a three-year work programme on Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems. The Task's aim was apply methods developed by Task 25, and to aid the implementation of mitigation projects and programs. The participating countries at the beginning of 2001 were the following 11 countries: Australia, Austria, Canada, Croatia, Denmark, Finland, Ireland, New Zealand, Sweden, the Netherlands, the United Kingdom, and the United States. Norway joined in 2001 and Ireland in 2002 (see appendix 1 for National Team Leader details).

The scope of Task 38 in the period 2001-2003 was to concentrate on the application of methods developed by Task 25, and to aid the implementation of mitigation projects and programs. Highlights of the Task are:

- The organization of seven Task Workshops, Conferences and Meetings on relevant and timely topics;
- The finalization of eight case studies, with the goal to assess and compare the GHG balances of concrete bioenergy and carbon sequestration projects;
- The publication of a FAQ brochure: A Task 38 brochure entitled "Answers to 10 Frequently Asked Questions about Bioenergy, Carbon Sinks and Global Climate Change" was finalized and printed for wide distribution.
- The set-up of a hyper-linked information system for all participating countries (country reports) on
  - general energy system and GHG emissions, bioenergy systems and LULUCF;
  - domestic policies and measures for bioenergy and C sequestration;
  - bioenergy and C sequestration implementation projects and research programs.
- The finalization of a Soil Carbon paper, looking at the relationship between soil carbon sequestration and bioenergy, and addressing the implications for the overall GHG balance of bioenergy and land use projects, and for carbon accounting under the Kyoto Protocol.

The Task also addressed issues concerning further methodological development such as

- national accounting of traded biomass fuels and harvested wood products,
- the role of bioenergy in the CDM;
- development of a new software tool for analysing the GHG balance and emission-saving - cost-effectiveness of biomass energy technologies - within the joint Task 38 and EU project BIOMITRE.

Some of the conclusions of the Task are:

- Bioenergy can have important synergies with carbon sequestration, creating win-win situations.
- Carbon sequestration is limited in terms of available land area, and carbon storage potential per unit of land. Bioenergy, on the other hand, can help overcome this limitation because fossil-fuel substitution benefits can be achieved on a repeated basis.
- There may be some decline in soil carbon associated with biomass production but this is negligible in comparison with the contribution of bioenergy systems towards greenhouse gas mitigation through avoidance of fossil fuel emissions.
- Biomass resources are not necessarily available in the same place as potential demand for energy services from biomass is greatest. Biomass trade is one means overcoming this problem.

## Overview of the Task

Task 38 builds on the achievements of Task 25, which concentrated on scientific-technical issues and method development. The new Task focused on application of these methodologies to mitigation projects and programs. Objectives of the task were:

- To develop, compare and make available integrated computer models for assessing GHG balances of bioenergy and carbon sequestration systems on the project, activity, and regional levels, and address scaling issues between these levels;
- To assess the life cycle GHG balance of such systems, including leakage, additionality, and uncertainties;
- To make comparisons of bioenergy systems with e.g. fossil energy systems, as well as comparisons of wood products with other materials such as steel and concrete;
- To analyse the country-level and regional potential of bioenergy, forestation, and other biomass-based mitigation strategies, including implications for atmospheric CO<sub>2</sub> reduction;
- To aid decision makers in selecting mitigation strategies that optimise GHG benefits, e.g. allocating biomass to energy vs. use as raw material; considering costs and benefits, as well as the practicalities of different mitigation strategies;
- To assist in the implementation of forestry, land-use and bioenergy options through methodological work and development of standards for carbon accounting in the energy and LULUCF sectors.

The participating countries at the beginning of 2001 were Australia, Austria, Canada, Croatia, Denmark, Finland, Ireland, New Zealand, Sweden, the Netherlands, the United Kingdom, and the United States. Norway joined in 2001 and Ireland in 2002 (see appendix 1 for National Team Leader details).

As in other Tasks, a Task Leader, appointed by the Operating Agent (the Republic of Austria), directs and manages the work programme. In each country participating in Task 38, a National Team Leader is nominated (in some cases two), responsible for the coordination of the national participation in the Task. For further details on Task 38, please refer to Appendices 1-2 and the Task 38 website at [www.joanneum.at/iea-bioenergy-task38](http://www.joanneum.at/iea-bioenergy-task38)

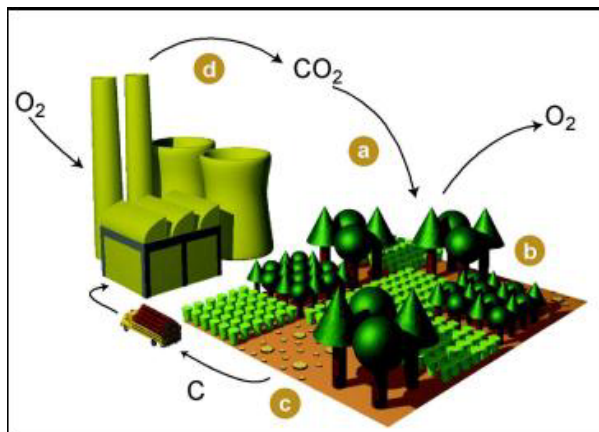


Fig.1: Illustration of the recycling of carbon. a: CO<sub>2</sub> is captured by the growing crops and forests; b: oxygen (O<sub>2</sub>) is released and carbon is stored in the biomass of plants; c: carbon in harvested biomass is transported to the power station; d: the power station burns the biomass, releasing the CO<sub>2</sub> captured by the plants back to the atmosphere. Considering the process cycle as a whole, there are no net CO<sub>2</sub> emissions from burning the biomass.

## Progress in R&D

Main outputs of the Task 38 work programme are:

- The finalization of case studies, with the goal to assess and compare the GHG balances of concrete bioenergy and carbon sequestration projects;
- The set-up of a hyper-linked information system for all participating countries (country reports);
- The finalization of a Soil Carbon Paper, looking at the relationship between soil carbon sequestration and bioenergy
- The publication of a Task 38 brochure entitled “Answers to 10 Frequently Asked Questions about Bioenergy, Carbon Sinks and Global Climate Change” for a wide distribution;
- The further development of the Task methodology, such as
  - national accounting of traded biomass fuels and harvested wood products,
  - the role of bioenergy in the CDM;
  - a new software tool for analysing the GHG balance and emission-saving cost-effectiveness of biomass energy technologies within the joint Task 38 and EU project BIOMITRE:
- The elaboration of different other reports and publications (e.g. Task 38 Folder, Carbon Cycle Paper, Biotrade Paper, EU Emission Trading paper, IPCC report, abstracts submitted to scientific conferences....)

Some of the outputs are described in more details below:

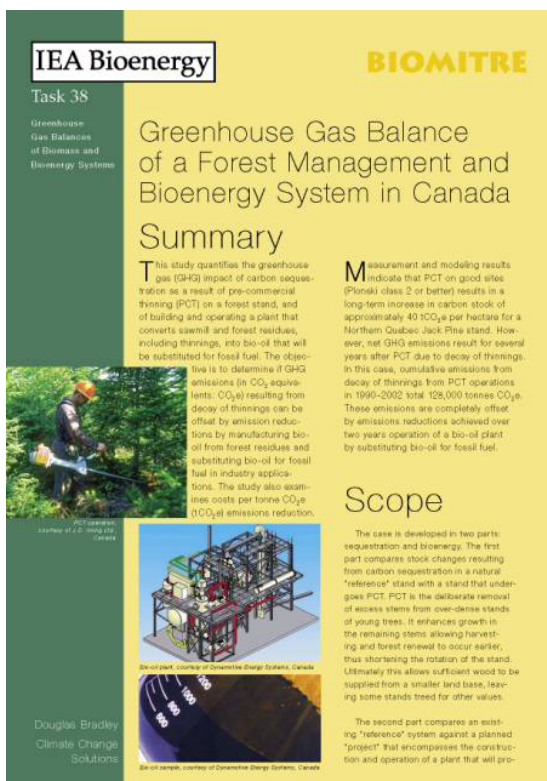
Case Studies: Work on case studies to analyze the GHG emission reductions of concrete bioenergy and carbon sequestration projects was carried out throughout the period. The goal is to assess and compare the GHG balances of such projects in the participating countries, and to make recommendations for optimizations of these systems. All case studies reports have been completed and are available on

<http://www.ioanneum.at/iea-bioenergy-task38/projects/task38casestudies/>.

Colour brochures on each of the case studies will also be produced for distribution.

The case studies include:

- Australia: GHG balance of two bioenergy systems (co-firing of biomass with coal and a wood fired conversion facility), both based on conventional hardwood plantation forestry;
- Finland and Sweden: Carbon dioxide balance of wood substitution: comparing concrete- and wood-framed buildings
- New Zealand: An Analysis of a combined heat and power bioenergy system in New Zealand indicated that the bioenergy system reduces greenhouse gas emissions by 16,235 t CO<sub>2</sub> e/yr when compared to the reference system. This equates to a GHG emission reduction of 0.08 t/t dry biomass used or 0.15 t/MWh of energy produced.
- United Kingdom: Two bioenergy systems in the UK were examined, an energy crop system and a wood fuel system. The wood fuel production had lower energy inputs and GHG emissions than the Miscanthus fuel production, and avoided emissions of 0.3228 kg CO<sub>2</sub> equivalent per kWh compared to 0.2621 kg CO<sub>2</sub> equivalent per kWh for the miscanthus system.
- Croatia: Results of a Croatian study on biodiesel indicate that use of biodiesel in the transportation sector in Croatia results in much lower GHG emissions than the use of fossil fuels. Enhanced use of biodiesel for the transport sector could be a valuable contribution to meet Croatia's GHG emissions reduction commitments under the Kyoto protocol. The mitigation costs of replacing diesel by biodiesel are in the range 243-327 € per avoided tonne of CO<sub>2</sub>-equivalent.
- Canada: GHG balance of a small pyrolysis plant using both sawmill residues and thinnings from a juvenile spacing program to produce bio-Oil, used either in a pulp mill limekiln or for biofuel export.
- USA: The US case study analyzing the impact of using anaerobic digestion in livestock waste management showed a 79% reduction in GHG emissions.
- Ireland: The Irish case study compared the greenhouse gas emissions of a peat burning electricity generation plant to co-firing peat with recovered wood. When co-firing 100,000 tonnes of recovered wood CO<sub>2</sub> emissions of 0.22kg per kWh could be avoided.



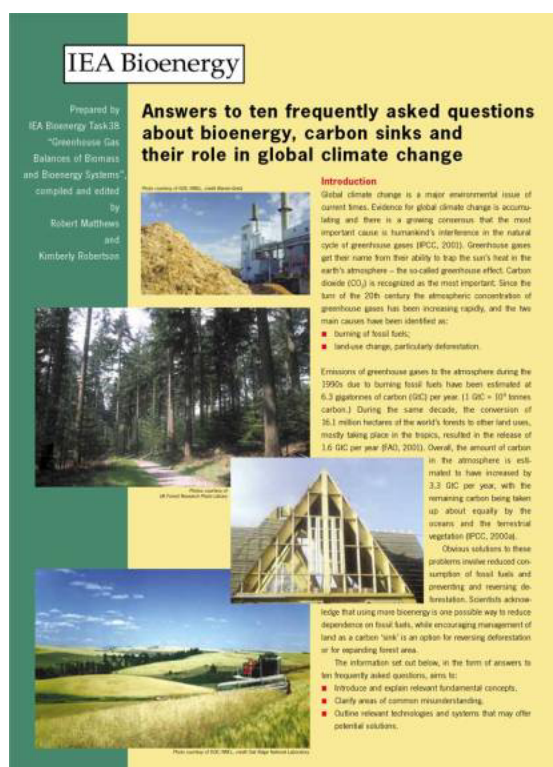
Country Reports: Work on the development of "country reports" as an online-information system was carried out through the period dealing with

- background information (general energy system and GHG emissions, general

- description of bioenergy systems, Land use change and forestry),
- information on domestic “policies and measures” (national, regional and local level),
- and on bioenergy and carbon sequestration projects (actual pilot projects, research),

The work aims to provide an overview of the relevant national activities on energy, bioenergy, greenhouse gas emission, land use, policies and RTD projects (all from the view of the Task 38 topic). A matrix with participating countries (columns) and the topics listed above (rows) has been developed as the “heart” of a hyper-linked system has been made available on the website. During the working sessions in Utrecht the status of the work was presented and evaluated by the NTLs, especially regarding what information concerning the 12 countries was already available and what was still missing. NTLs were invited to deliver the information still needed. The country report was also presented to ExCo 49 in Vienna, and ExCo asked for a proposal how this could be expanded to more generic issues relevant to ExCo and/or other Tasks. A proposal was presented at ExCo 50 in Finland. Ireland as a new participating country delivered information on this item. This is an ongoing action with updates. Current status is documented on the website under: [www.joanneum.at/iea-bioenergy-task38/countryreports](http://www.joanneum.at/iea-bioenergy-task38/countryreports)

FAQ brochure: A Task 38 brochure entitled “Answers to 10 Frequently Asked Questions about Bioenergy, Carbon Sinks and Global Climate Change” was finalized and printed for wide distribution. The contribution from Task participants, as well as the Task Leader of Task 35, Yrjö Solantausta, are gratefully acknowledged. This project was coordinated by Robert Matthews of the UK Forestry Commission and Kimberly Robertson of New Zealand Forest Research. Initially 5000 copies were printed and distributed worldwide to NTLs (National Team Leaders), ExCo Members, all Task Leaders and many other organizations who asked for copies. A further reprint was required in 2002. A translation into Italian was conducted by the Italian organization AIEL in 2003. Task Management can be contacted for hardcopies and can also be downloaded from the website at [www.joanneum.at/iea-bioenergy-task38/publication/task38faq.pdf](http://www.joanneum.at/iea-bioenergy-task38/publication/task38faq.pdf)



One of the main conclusions of the FAQ is that GHG emission reduction can be achieved through both carbon sinks and bioenergy although the long term potential is greater for bioenergy. The current global potential carbon sink through vegetation management has been estimated at between 60 and 87 GtC over 50 years (1.2 to 1.7 GtC per year), or 7-15% of average fossil fuel emissions for the period 2000 to 2050 (IPCC, 1996, 2000a,b). Ultimately the scope for increasing carbon stocks in vegetation will reach its ecological or practical limits, and other measures will be

needed. The carbon sink potential might be achieved at the same time as realizing greater bioenergy production, with much of the future bioenergy supply probably coming from some of the newly created forests or adapted agricultural systems. The potential global contribution of bioenergy has been estimated to be between 95 and 280 EJ in the year 2050 (Hall and Scrase, 1998), leading to an ongoing potential reduction/avoidance in emissions of between 1.4 and 4.2 GtC per year or between roughly 5% and 25% of projected possible fossil fuel emissions for the year 2050. The maximum energy that may technically be feasible to supply globally from bioenergy sources has been estimated to be in excess of 1300 EJ (IPCC, 2000b).

Soil Carbon Paper: The Task worked on a paper entitled “**Does soil carbon loss in biomass production systems negate the greenhouse gas benefits of bioenergy?**” which looks at the relationship between soil carbon sequestration and bioenergy, addressing the implications for the overall GHG balance of bioenergy and land use projects, and carbon accounting under the Kyoto Protocol. The paper was coordinated by Annette Cowie (State Forests of New South Wales, Australia) and includes collaborators from most countries participating in Task 38, as well as one representative each from Tasks 30 and 31. There are two outputs from this work: a scientific paper in a 2004 Special Issue of the journal *Mitigation and Adaptation Strategies* and a full report on [www.joanneum.at/iea-bioenergy-task38/projects/task38casesudies/](http://www.joanneum.at/iea-bioenergy-task38/projects/task38casesudies/). Modelling results in the paper demonstrate that loss of soil carbon in bioenergy systems is associated with declines in the resistant plant matter and humified soil C pools. However, published experimental data and modelling results indicate that total soil C loss in bioenergy systems is generally small. Thus, although there may be some decline in soil carbon associated with biomass production, this is negligible in comparison with the contribution of bioenergy systems towards greenhouse mitigation through avoided fossil fuel emissions.

Carbon Cycle Paper: The Task (authors: Carly Green and Kenneth Byrne) prepared a 30 pages paper on “Biomass: Impact on Carbon Cycle and Greenhouse Gas Emissions”, published in the *Encyclopedia of Energy*, Elsevier Inc., 2004. The final paper has been presented in the Task 38 Internal Meeting in Östersund.

The EU project *BIOMITRE (BIOmass-based Climate Change MITigation through Renewable Energy)*: This project, developed by a consortium of Task 38 participants, started in 2003. A cooperative financing scheme using European Commission funds and Task 38 funds has been developed for this project. The results will be available to both the EC and Task 38. The project is an expansion of the Task 38 case studies. The aim is to develop a user-friendly software tool for analysing the greenhouse gas balance and emissions-saving cost-effectiveness of biomass energy technologies. Its preparation will be based on the Task 38 standard methodology. The final BIOMITRE tool will address most of the bioenergy fuel chains as a comprehensive tool. The tool is also meant to allow the user to constringe input parameters and generate summary outputs of the energy consumption, GHG emissions and cost balance for generic or specific bioenergy chains. The software tool will be tested and used to generate further case study material. The tool, a guide for users and all relevant supporting material will be disseminated by appropriate means through existing national and international networks.

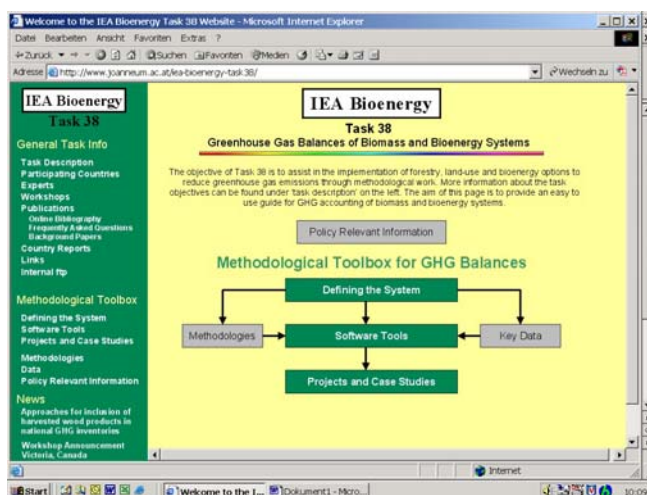
The BIOMITRE project is also developing single bioenergy chains, such as the biodiesel tool in appendix 3. These simpler tools will be further optimized for user-friendliness and simplicity. For more information see [www.joanneum.at/biomitre/](http://www.joanneum.at/biomitre/)

Should we trade biomass, bio-electricity, CO<sub>2</sub> credits or green certificates? The Task prepared a paper to address the available options for linking the global biomass resource and services supplies with the global demand for energy fuels and services, both in the conventional form of electricity and heat but also in the new forms of green/renewable energy certificates and CO<sub>2</sub> emissions trading schemes. The paper has been presented at the 2004 EU biomass conference in Rome.

The four options addressed in this paper have become of interest recently as the international trade of biomass or energy carriers from biomass has become part of the portfolio of energy companies and countries to increase the share of biomass in their fuel mix and to meet environmental objectives. This trade is growing rapidly and in the longer term a global market of renewable energy carriers derived from biomass may emerge. Advantages of such a market are potentially plentiful. Most important may be the effect that such a market may indeed lead to development and sustainable use of the vast bio-energy production potential in many world regions. The paper also introduces and the authors will further develop a discussion and analysis of various essential criteria that influence what option suits best for each combination of (potential) exporting and importing country. However, all those options can contribute to building sustainable biomass markets and increasing the share of biomass in the global energy use. The variety of tools (physical biomass trade, electricity trade, credits and certificates) allows for selecting the most efficient mechanism for each of those unique situations.

Task Proposal for the next triennium 2004-2006: The proposal on “Greenhouse Gas Balances of Biomass and Bioenergy Systems” has been developed and finalized in collaboration with Task38 NTLs. This is available on the website at [www.joanneum.at/iea-bioenergy-task38/description/](http://www.joanneum.at/iea-bioenergy-task38/description/)

Carbon accounting for internationally traded harvested wood products: In the first half of 2001 the Task entertained an e-mail discussion list on carbon accounting for harvested wood products, which is an issue in national inventories of greenhouse gas emissions.



Task 38 website: has been re-designed to focus more on the substance of biomass fuel cycles, in addition to the current content. Work on the new structure for the website was implemented by the end of 2003. The Task 38 bibliography has been modified into a database-system which can be accessed through the website:

everyone can add new entries, which will be checked by the Task management. NTLs and other Task participants are invited to add new literature information to this database: [www.joanneum.at/iea-bioenergy-task38/publications/bibliography](http://www.joanneum.at/iea-bioenergy-task38/publications/bibliography) . Updating of the website occurs continually and routinely after every Task workshop when documentation of PowerPoint presentations and videos of the Task 38 conferences are added.

Task 38 overheads: A set of transparencies for general use by participants (40 overheads) was updated. The overheads cover general Task information and specific results from participating countries.

FTP System : has been set up as a Task document management system for use by the participants of Task 38. The FTP is hosted at Joanneum Research and National Team Leaders (and their teams) can access internal documents from there. The system allows joint work on shared documents, and filing of power point presentations, draft reports, and other internal documents. It contains an announcement section enabling NTLs to announce events.

Task 38 folder: the new folder was finalized and distributed, to replace the Task 25 folder: This folder contains information on methodologies for GHG balances developed by Task 25, and an overview of the objectives, work scope and results of Task 38. Copies are available from the Task management or can be downloaded from: [www.joanneum.at/iea-bioenergy-task38/description/task38folder.pdf](http://www.joanneum.at/iea-bioenergy-task38/description/task38folder.pdf)

EU ETS: The Task elaborated a paper describing the role of renewable energy in the EU Emissions Trading System: "EU ETS: Insufficient Incentives for Renewables", which has been published in "Joint Implementation Quarterly" (see also appendix 2). The paper focuses on the incentives that bioenergy (and other renewables) receive as part of the European, or any other future emissions trading system, and how the situation could be improved from the view of bioenergy.

Bioenergy and CDM: The Task leader also presented a paper entitled "Bioenergy and Clean Development Mechanism" at COP 9 (Conference of the Parties to the UNFCCC) in Milan, 3 December 2003, (see also appendix 2). The issue at stake here is that bioenergy is generally accepted as a project type in the CDM, as long as it can be proven that fossil fuels can be replaced. However, projects to enhance the conversion efficiency of bioenergy systems (such as cooking applications), or demand-side management projects in bioenergy systems are not eligible, because these would only reduce emissions from land use, but not from fossil fuels. Carbon effects of land-use activities, on the other hand, can only be claimed in the CDM if they are related to afforestation and reforestation. A dialogue with stakeholders (including FAO, and the CDM Methodologies Panel) has been initiated.

IPCC report: Several Task participants are Lead Authors of the IPCC (Intergovernmental Panel on Climate Change) Good Practice Guidelines for Land Use, Land-use Change and Forestry. Task minutes have been used to discuss this IPCC project and to maximize the input by the Task at the level of authors as well as expert reviewers. The Task 38 contribution for the IPCC report can be found at: [http://www.ipcc-nggip.iges.or.jp/lulucf/gpqlulucf\\_unedit.html](http://www.ipcc-nggip.iges.or.jp/lulucf/gpqlulucf_unedit.html)

Abstracts submitted to scientific conferences:

- 12th European Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection in Amsterdam, the Netherlands, 17-21 June

2002; Title: "Bioenergy, carbon sequestration and greenhouse gases: project case studies carried out by IEA Bioenergy Task 38" (accepted as plenary presentation).

- World Renewable Energy Congress VII in Cologne, Germany, 29 June –5 July 2002; Title: "Bioenergy, Land Use, Greenhouse Gases, and Climate Change: Latest Results from IEA Bioenergy Task 38"(paper accepted for oral presentation).

Progress reports for ExCo meetings, annual reports and minutes of the Task Meetings: Progress reports for all ExCo meetings, 3 annual reports and minutes for all 7 IEA Bioenergy Task 38 meetings have been delivered.

NTL Guidelines: Guidelines defining the role and duties of National Team Leaders have been drafted by Task 38, and have been presented to the Executive Committee.

#### Work programme items not completed

- Historically, has bioenergy replaced other energy sources or increased total energy capacity, etc. It was decided by task participants not to follow up on this item.
- Development of a database of bioenergy projects specifically aimed at GHG mitigation (for example, JI projects). Task participants decided that this was beyond the scope of the task.
- Analysis of the GHG balance of an integrated system that produces multiple products (e.g., electricity, methanol, hydrogen, etc.) from biomass. This will be partly covered by BIOMITRE and will be a continued issue in the new Task period.

#### Work items completed, but originally not planned in the work programme:

- Work on emission trading (see above)
- Bioenergy and CDM (see above)

The philosophy of the Task was flexibility: new items arising during the task period have been integrated, less interesting items have been postponed/canceled, and in some cases (e.g. multiple products) work is continuing.

Papers presented and published or submitted to publication are documented in Appendix 2.

## **Collaboration with other Tasks**

Task 38 collaborated

- with Task 35 on the use of biofuels as a commodity in international trade for reducing CO<sub>2</sub> emissions (see 'Task meetings and workshops' - the Joint Workshop on Biofuel Trade in Utrecht and the half-day workshop on the same subject, as part of the 12<sup>th</sup> European Biomass Conference in Amsterdam).
- with Task 29 and COST E21 (see 'Task meetings and workshops' - the Graz Workshop)
- with Tasks 30 and 31 (see above 'Progress in R& D' –the Soil Carbon Paper).

## Task Meetings and Workshops

In the last triennium seven Task Workshops, Conferences and Meetings, which play an important role in the IEA Bioenergy Tasks for information dissemination and development of the Task work programmes, have been organized in different participation countries, always in cooperation with national team leaders and national organizations.

Workshop 1: this workshop took place on 26-30 March, 2001, in Canberra, Australia. It was jointly organised by State Forests New South Wales, Bioenergy Australia, CSIRO Forestry and Forest Products (all 3 institutions located in Australia), and Joanneum Research of Austria. Workshop topic: "**Carbon Accounting and Emissions Trading Related to Bioenergy, Wood Products and Carbon Sequestration**".

- Session 1: Carbon accounting for forestry and land use.
- Session 2: Carbon accounting of wood products and biofuels.
- Session 3: Managed forests for wood products, carbon sequestration and/or bioenergy: their role in greenhouse gas policy.
- Session 4: Trading in carbon credits from bioenergy and sequestration projects.

The proceedings of the workshop have been published and are, as well as video recordings and powerpoint presentations, available online at: [www.joanneum.at/iea-bioenergy-task38/procchoi.htm](http://www.joanneum.at/iea-bioenergy-task38/procchoi.htm).

Workshop 2: this workshop took place in Edinburgh and Dunkeld, UK, 12-16 November, 2001. It was jointly organised by Forest Research, UK and Joanneum Research, Austria. The "open" part of the workshop on 12-13 November in Edinburgh was titled: "**Successful Strategies for Biomass-based GHG Emissions Reduction and Mitigation: Translating Research into Policy and Implementation**".

On 12 Nov. there was an opportunity for UK and international experts to make presentations on research projects, results and policy developments. The workshop demonstrated success stories, ongoing developments, but also problems and barriers to implementation of bioenergy and carbon sequestration projects and how to overcome them, including potential JI (Joint Implementation) and CDM (Clean Development Mechanism) projects. 13 Nov. featured a study tour of relevant sites in Scotland (a short rotation coppice growth monitoring trial in Balbirnie, a forest carbon sink monitoring trial in Griffen, an UN-ICP level forest monitoring plot in Errochty, and the Forest Enterprise/Forest Research UK Woodland Assurance Scheme monitoring plot in Allean). Detailed documentation of the workshop, including videos of the presentations and Powerpoint files, are available on the Task 38 website at [www.joanneum.at/iea-bioenergy-task38/fnew1.htm](http://www.joanneum.at/iea-bioenergy-task38/fnew1.htm). A workshop summary is under preparation.

The Task 38 internal working sessions took place in Dunkeld, 14-16 November and covered the following items:

- Country reports (details see below);
- Case studies of bioenergy and carbon sequestration projects for climate-change mitigation (details see below);
- Paper on soil carbon and bioenergy;
- Other business items (ie planning of the next workshops, defining of a new structure for the website, preparation of a new EU proposal, new Task 38 folder, Task 38 Intranet ).



Workshop 3: From 22-24 April 2002 a workshop jointly organized by Tasks 29, 38 and by the COST E21 network (Contribution of Forests and Forestry to Mitigating the Greenhouse Effect) on

**“The economics of substitution management to reduce net GHG emissions & Forest-based carbon mitigation projects: dealing with permanence, leakage, additionality, uncertainties, and socio-economic and environmental issues”**

took place in Graz. 3 working groups have been created. The aim of this workshop was to write timely papers on the above-mentioned issues, to be provided to negotiators under the United Nations Framework Convention on Climate Change.:

- Working group 1 is currently finalising a paper on **“The role of wood for substitution in reducing net GHG emissions”**, which is planned to be published in the „Special Issue“ of the journal „Mitigation and Adaptation Strategies for Global Change“.
- Working group 2 prepared a paper entitled **“Forest-Based mitigation projects: Options for carbon accounting and for dealing with non-permanence”**, which has been submitted to the UNFCCC and is available under: <http://unfccc.int/resource/webdocs/2002/12.pdf>.
- Output of working group 3 is a paper on **“A Sustainability Framework for Enhancing the Long-Term Success of LULUCF Projects”** which has been submitted for publication in the journal “Climate Change”.

Further information about the workshop can be found at: [www.joanneum.at/iea-bioenergy-task38](http://www.joanneum.at/iea-bioenergy-task38) (click on “Workshops”, then “Graz 2002”).

Workshop 4: In June 2002 Task38 co-organised the following meetings:

- **Internal Task 38 working sessions** (12-13 June 2002) in cooperation with NOVEM and Utrecht University in the Netherlands and
- **A joint Task 35 and Task 38 working session on Biofuel Trade** (June 14, 2002, Utrecht, Netherlands). The aim was to conduct discussions on a future collaborative in-depth analysis of economic and GHG aspects of biomass trade and to develop a work plan for future collaboration between the two Tasks. It was decided that Task 35 would select 2 concrete bio-fuel trade chains, for which Task 38 will calculate GHG balances. It was also agreed to prepare in cooperation a position paper on this item.
- A open workshop on **“Biomass Trade: economic and greenhouse gas**

**considerations (Biotrade)”** in cooperation with Task 35, organised as Conference workshop 3 of the **12<sup>th</sup> European Conference on Biomass for Energy, Industry, and Climate Protection** (on June 19<sup>th</sup> 2002): The main objective of this workshop was to analyse economic and GHG aspects of international biomass trade. Topics addressed were:

- GHG and energy balances and economics of international bio-energy trading chains;
- Biomass resource potentials;
- Optimal use of land in terms of the CO2 balance: sequestration, indigenous utilisation and export compared, trade-offs and synergies discussed;
- Formulation, implementation and verification of criteria for sustainable bio-energy trade;
- Policy frameworks, pilot projects and implementation schemes.

Further information, including power point presentations and video files about the workshop, can be found at: [www.joanneum.at/iea-bioenergy-task38](http://www.joanneum.at/iea-bioenergy-task38) (click on “Workshops”, then “Amsterdam”).

Workshop 5: Task 38 organised in cooperation with Hallam University of Sheffield, UK, the following two meetings in Sheffield:

- The **Task 38 workshop** from 11-12 March 2003 covered the following items:
  - draft proposal of work programme 2004-2006
  - case studies,
  - soil carbon paper
  - carbon cycle paper
  - new structure of the Task38 website
  - country reports
  - other Task business (i.e. planning for the next workshop/conference, updated set of T38 transparencies, posters, new position paper/FAQ on biofuel trade).
- The **BIOMITRE Kick-off Meeting** from 13-14 March 2003 (more information on BIOMITRE see below).



Workshop 6: In September – October 2003 Task38 co-organised jointly with Mid Sweden University the following meetings in Östersund, Sweden:

- A **Joint BIOMITRE Task 38 Project Meeting** (September 25-27, 2003);
- An **IEA Bioenergy Task 38 internal Meeting** (September 29, 2003)
- An open **IEA Bioenergy Task 38 conference on “Efficient Use of Biomass for Greenhouse Gas Mitigation”** with ½ day Excursion to a new large-sized Biomass CHP plant (September 30 – October 1, 2003).

Further information, including power point presentations and video files about the conferences, can be found at: [www.joanneum.at/iea-bioenergy-task38/workshops](http://www.joanneum.at/iea-bioenergy-task38/workshops)

Workshop 7: In cooperation with Force Consulting Ltd., the Ministry for Environment in New Zealand and the New Zealand Climate Change Office, the Task organised the following meetings in Rotorua, New Zealand:

- An open **IEA Bioenergy Task 38 conference on “The Role of Carbon Sequestration and Bioenergy in national and International Greenhouse-Gas Markets”** with a 1 day Field Tour to e.g. a bioethanol facility and a forest harvesting operation (22 – 23 March, 2004): The conference provided a forum for discussions on
  - **Bioenergy and carbon sequestration projects: policies, accounting, and credit trading:** overview of climate policy in NZ, domestic projects mechanisms and Bioenergy/carbon sequestration in NZ, relationship between emissions trading systems and the Kyoto Protocol flexible mechanisms, the EU emissions trading scheme as an example.
  - **Carbon monitoring and accounting of agriculture, forestry and harvested wood products:** accounting for afforestation and reforestation activities – implementation of the LULUCF GPG, accounting and reporting of emissions from harvesting, HWP and bioenergy by an alternative accounting system in NZ. Further information, including power point presentations and video files about the conferences, can be found at: [www.joanneum.at/iea-bioenergy-task38/workshops](http://www.joanneum.at/iea-bioenergy-task38/workshops)
- An **IEA Bioenergy Task38 Internal Meeting** (24-25 March, 2004), with official closure of the Task period 2001 – 2003, including a reflection upon last 3 years’ activities and the official opening of the next Task period.

On the way home from New Zealand to to Europe Task 38 organised in cooperation with Bioenergy Australia, a ½ day IEA Bioenergy Task 38 workshop in Sydney, Australia (26 March, 2004). Further information, including power point presentations, can be found at: [www.joanneum.at/iea-bioenergy-task38/workshops](http://www.joanneum.at/iea-bioenergy-task38/workshops)

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## Appendix 1

### Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems

National Team Leaders:

<p><u>AUSTRALIA</u>  <b>Annette Cowie</b>  State Forests New South Wales  P.O.Box 100 Beecroft, New South Wales 2119  AUSTRALIA  Phone: +61 2 9872-0138 Fax: +61 2 9871-6941  e-mail: annettec@sf.nsw.gov.au</p>	<p><u>IRELAND</u>  <b>Kenneth Byrne</b>  Centre for Hydrology, Micrometeorology &amp; Climate Change  Department of Civil and Environmental Engineering  University College Cork  IRELAND  Phone: +353 21 490 3025 Fax: +353 21 427 6648  e-mail: kenneth.byrne@ucd.ie</p>
<p><u>AUSTRIA:</u>  <b>Bernhard Schlamadinger</b> (TASK LEADER)  Joanneum Research  Elisabethstrasse 5, A-8010 Graz,  AUSTRIA  Phone: +43 316 876 1340 Fax: +43 316 876 91340  e-mail: bernhard.schlamadinger@joanneum.at</p> <p><b>Susanne Woess-Gallasch</b> (National Team Leader)  Joanneum Research  Phone: +43 316 876 1330 Fax: +43 316 876 91330  e-mail: susanne.woess@joanneum.at</p>	<p><u>THE NETHERLANDS:</u>  <b>Kees Kwant</b>  NOVEM  Catharijnesingel 59, Postbus 8242,  3503 RE Utrecht, The Netherlands  Phone: +31 30 2393 587, Fax: +31 30 2316 491  e-mail: a.de.zeeuw@novem.nl</p> <p><b>Andre Faaij</b>  Utrecht University  Padualaan 14, 3584 CH Utrecht, The Netherlands  Phone: +31 30 2393 587, Fax: +31 30 2316 491  e-mail a.p.c.faaij@chem.uu.nl</p>
<p><u>CANADA:</u>  <b>Terry Hatton</b>  Canadian Forest Service, Natural Resources  Canada  580 Booth St., Ottawa, Ontario  K1A OE4 Canada  Phone: +1 613 947 9077, Fax: +1 613 947 9020  e-mail: thatton@ncran.gc.ca</p>	<p><u>NEW ZEALAND:</u>  <b>Kimberly Robertson</b>  Force Consulting Ltd.  444 Pukehangi Rd. Rotorua  New Zealand  Phone: +64 (0)7 343 9559, Fax: +64 (0)7 343 9557  e-mail: kimberlyrobertson@xtra.co.nz</p>
<p><u>CROATIA:</u>  <b>Snjezana Fijan-Parlov</b>  EKONERG  Koranska 5, PP 144, HR-10000 ZAGREB  CROATIA  Phone: +385 1 6000-122, Fax: +385 1 6171-560  e-mail: sfijan@ekonerg.hr</p>	<p><u>NORWAY:</u>  <b>Birger Solberg</b>  Agricultural Univ. of Norway, Dep.of Forest Sciences  P.O. Box 5044, N-1432 Ås  Norway  Phone: +47 64 94 88 80, Fax: +47 64 94 88 90  e-mail: birger.solberg@isf.nlh.no</p>
<p><u>DENMARK:</u>  <b>Niels Heding</b>  Danish Forest and Landscape Research Institute  Hoersholm Kongevej 11  DK 2970 Hoersholm  Phone: +45 45 763 200, Fax: +45 45 763 233  e-mail: NIH@fsl.dk</p>	<p><u>SWEDEN:</u>  <b>Leif Gustavsson</b>  Mid Sweden University  SE-831 25 Östersund  SWEDEN  Phone: +46 63 165 979, Fax: +46 63 165 450  e-mail: leif.gustavsson@mh.se</p>
<p><u>FINLAND:</u>  <b>Sampo Soimakallio</b>  VTT-Processes  P.O. Box 1606,FIN-02044 VTT (Espoo)  FINLAND  Phone: +358 9 456 6767, Fax: +358 9 456 7026  e-mail: sampo.soimakallio@vtt.fi</p> <p><b>Kim Pingoud</b>  VTT-Processes  Phone: +358 9 456 5074, Fax: +358 9 456 6538  e-mail: kim.pingoud@vtt.fi</p>	<p><u>UNITED KINGDOM:</u>  <b>Robert Matthews</b>  Forestry Commission. Research Agency,  Mensuration Branch  Alice Holt Lodge, Wrecclesham, Farnham, Surrey  GU10 4LH UNITED KINGDOM  Phone: + 44 1420 526 235, Fax: + 44 1420 234 50  e-mail: r.matthews@forestry.gov.uk</p>

**UNITED STATES:**

**Matthew Ringer**  
National Renewable Energy Laboratory  
1617 Cole Blvd. MS-1613, Golden, Colorado, U.S.A.  
Phone: +1 303 384 7747, Fax: +1 303 384 6363  
e-mail: matthew\_ringer@nrel.gov

Operating Agent: **Josef Spitzer**, JOANNEUM RESEARCH, Elisabethstrasse 5, A-8010 Graz,  
AUSTRIA, Phone: +43 316 876 1332, Fax: +43 316 876 1320  
e-mail: josef.spitzer@joanneum.at  
The Task Leader is assisted by Susanne Woess-Gallasch

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**Appendix 2**  
**LIST OF Task 38 REPORTS AND PUBLICATIONS**

**Presentations and minutes:**

Minutes from the internal task meetings in

- Canberra, Australia, 30 March 2001
- Edinburgh and Dunkeld, UK, 15-16 November, 2001
- Utrecht, the Netherlands 12-13 June 2002
- Sheffield, UK, from 11-12 March, 2003.
- Ostersund, Sweden 29 September, 2003.
- Rotorua, New Zealand, 24-25 March, 2004

**B. Schlamadinger, I. Jürgens:** Bioenergy and the Clean Development Mechanism. November 2003. Oral presentation at the EU Biomass Conference in Rome, June 2004. Draft submitted for publication.

**B. Schlamadinger, A. Faaij, and E. Daugherty:** Should We Trade Biomass, Electricity, Renewable Certificates, or CO2 Credits? Oral presentation at the EU Biomass Conference in Rome, June 2004. Draft submitted for publication.

**B. Schlamadinger:** IEA Bioenergy Task38: Greenhouse Gas Balances of Biomass and Bioenergy Systems. Presentation at the workshop: The Biofuels Directive(s): potential for climate protection? Norwich, UK, 9 September 2003.

**K. A. Robertson, B. Schlamadinger, D. Bradley, A. Cowie, A. Faaij, L. Gustavsson, S. Fijan-Parlov, K. Kwant, M. Mann, R. Matthews, N. Heding, K. Pingoud, I. Savolainen, and B. Solberg, and S. Woess-Gallasch:** Bioenergy, Land Use, Greenhouse Gases, and Climate Change: Latest Results from IEA Bioenergy Task 38. Presentation at World Renewable Energy Congress VII in Cologne, Germany, 29 June –5 July 2002; oral presentation, submitted for publication.

**Publications:**

**C. Green and K. A. Byrne:** Biomass: Impact on Carbon Cycle and Greenhouse Gas Emissions. In: Encyclopedia of Energy, Elsevier Inc., 2004 (can be ordered: [www1.elsevier.com/homepage/sai/encycofenergy/Orderform.htm](http://www1.elsevier.com/homepage/sai/encycofenergy/Orderform.htm)).

**R. Madlener, C. Robledo, B. Muys, Bo Hektor and J. Domac:** A Sustainability Framework for Enhancing the Long-Term Success of LULUCF Projects. Draft submitted for publication in "Climate Change".

**B. Schlamadinger, K. Kwant and National Team Leaders of IEA Bioenergy Task 38:** EU ETS: Insufficient Incentives for Renewables. In: Joint Implementation Quarterly, Vol.9 –No. 4, Paterswolde, the Netherlands, December 2003.

**B. Schlamadinger, L. Auckland, S. Berg, D. Bradley, L. Ciccicarese, V. Dameron, A. Faaij, C. Forner, M. Jackson, G. Marland and R. Sikkema:** Forest-based carbon mitigation projects: Options for carbon accounting and for dealing with non-permanence. August 2002 submitted to UNFCCC and is available under: <http://unfccc.int/resource/webdocs/2002/12.pdf>.

**Greenhouse Gas Balances of Biomass and Bioenergy Systems: Task 38, an international research collaboration under the auspices of the IEA** (Folder). May 2002. Available at [www.joanneum.at/iea-bioenergy-task38/publications/](http://www.joanneum.at/iea-bioenergy-task38/publications/)

**K. A. Robertson, B. Schlamadinger, D. Bradley, A. Cowie, A. Faaij, L. Gustavsson, S. Fijan-Parlov, K. Kwant, M. Mann, R. Matthews, N. Heding, K. Pingoud, I. Savolainen, and B. Solberg:** Bioenergy, carbon sequestration and greenhouse gases: project case studies carried out by IEA Bioenergy Task 38. In: Proceeding of the 12th European Biomass Conference held in Amsterdam, the Netherlands, 17-21 June 2002; p. 53-56.

**Matthews R. and Robertson K.** Answers to ten frequently asked questions about bioenergy, carbon sinks and their role in global climate change. Folder prepared by IEA Bioenergy Task 38. Sept. 2001 and reprinted in 2002. Available at [www.joanneum.ac.at/iea-bioenergy-task38/publication/task38faq.pdf](http://www.joanneum.ac.at/iea-bioenergy-task38/publication/task38faq.pdf).

**Schlamadinger B., Woess-Gallasch S. and Cowie A. (Editors).** Carbon accounting and emissions trading related to bioenergy, wood products and carbon sequestration. Proceedings (19 papers) of the Task38 workshop in Canberra, Australia, 26-30 March 2001. 200 p. July 2001. Available at [www.joanneum.at/iea-bioenergy-task38/procchoi.htm](http://www.joanneum.at/iea-bioenergy-task38/procchoi.htm)

**Cowie A, Smith P, and Johnson D.** Does soil carbon loss in biomass production systems negate the greenhouse benefits of bioenergy? Available at [www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/)

**Cowie A.** GHG balance of two bioenergy systems (co-firing of biomass with coal and a wood fired conversion facility), both based on conventional hardwood plantation forestry. Available at [www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/)

**Gustavsson L, Pingoud K, and Sathre R.** Carbon dioxide balance of wood substitution: comparing concrete- and wood-framed buildings. Available at [www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/)

**Robertson K.** Assessment of the GHG balance of a bioenergy cogeneration plant (heat and electricity) based on the use of sawmill residues; Available at [www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/)

**Heaton R.** The Greenhouse Gas and Energy benefits of a *Miscanthus* and a wood fuelled heating system. Available at [www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/)

**Fijan- Parlov S.** Assessment of the GHG emissions reduction potential by biodiesel production in the context of Joint Implementation. Available at [www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.at/iea-bioenergy-task38/projects/task38casestudies/)

**Bradley D.** GHG balance of a small pyrolysis plant using both sawmill residues and thinnings from a juvenile spacing program to produce bio-Oil, used either in a pulp mill limekiln or for export of biofuel. Available at [www.joanneum.ac.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.ac.at/iea-bioenergy-task38/projects/task38casestudies/)

**Turnbull J.** Assessment of the GHG emission reduction potential associated with anaerobic digestion of organic wastes in a Californian County (Ventura). Available at [www.joanneum.ac.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.ac.at/iea-bioenergy-task38/projects/task38casestudies/)

**Lappi S, and Byrne K.A.** Greenhouse Gas Budgets of Peat Use for Energy in Ireland. Available at [www.joanneum.ac.at/iea-bioenergy-task38/projects/task38casestudies/](http://www.joanneum.ac.at/iea-bioenergy-task38/projects/task38casestudies/)

### Appendix 3 Appendix 3: BIOMITRE - ONLINE CALCULATOR

BIODIESEL from Rapeseed: Energy Balances, GHG Emissions, and Costs*							Summary		
Choose Reference Country :		UK					Energy	Emissions	Cost
Input Table	Energy Inputs	Uncertainty	Output Table	E. Demand (MJ/t.bd)	Uncertainty	GHG Emissions (kg.eq.CO2/t.ros)	Uncertainty	Costs Euros/t.bd	
<b>Cultivation</b>			<b>Cultivation</b>						
Nitrogen fertilizer [N] Rate (kg/ha)	196.0		ammonium nitrate fertiliser [N]	4010.2		111.9		47.7	
[N] manufacturing energy input (MJ/kg)	40.0		other fertilisers [P, K, Lime]	643.0		30.0		10.0	
Phosphorus fertilizer Rate (kg/ha)	50.0		all sprays [pesticides, herbicides...]	386.7		7.6		0.0	
Potassium fertilizer Rate (kg/ha)	48.0		diesel fuel consumption	1333.9		93.0		30.0	
Lime Rate (kg/ha)	18.9		Subtotal	6393.4		910.9		73.7	
Land hectares /per tonne biodiesel	0.924		reference system [avoided]	55.6		36.0		0.0	
Diesel fuel use (MJ/ha)	2385.0		Net subtotal [system - reference]	5877.7		875.0		73.7	
<b>Transport, Drying and Storage</b>			<b>Transport, Drying and Storage</b>						
Raw material trip distance (km)	260.0		Transport [fuel, vehicle, maintn.]	56.7		36.6		10.3	
Drying (fuel oil MJ/t dried oilseed)	305.0		Drying [fuel oil]	571.1		42.1		2.2	
Storage (kWh/t dos)	116		Storage [electricity]	27.2		114		0.9	
			Subtotal	105.0		90.7		13.5	
<b>Solvent Extraction</b>			<b>Solvent Extraction</b>						
Natural gas (MJ/t cro)	2237.5		Natural gas	1696.8		86.6		2.4	
Electricity (kWh/t cro)	84.0		Electricity	637.0		33.5		2.1	
			Subtotal (MJ/t cro)	2459.9		122.8		5.1	
<b>Refining</b>			<b>Refining</b>						
Electricity (kWh/t)	3.1		Electricity	316		17		0.1	
Natural gas (MJ/t refined bd)	178.0		Natural gas	81.6		9.3		0.3	
Heavy Fuel Oil (MJ/t)	20.0		Heavy Fuel Oil	20.4		1.5		0.1	
Light Fuel Oil (MJ/t refined bd)	152.0		Light Fuel Oil	155.0		114		0.6	
			Subtotal	4619		28.0		1.0	
<b>Esterification</b>			<b>Esterification</b>						
Electricity (kWh/t bd)	23.0		Electricity	223.0		11.7		0.0	
Natural gas (MJ/t bd)	102.0		Natural gas	1359.4		69.4		1.9	
Heavy Fuel Oil (MJ/t bd)	110		Heavy Fuel Oil	156.1		11.5		0.4	
Light Fuel Oil (MJ/t bd)	110		Light Fuel Oil	156.1		11.5		0.6	
Caustic Soda (kg/t)	12.0		Caustic Soda	209.3		2.6		0.0	
Methanol (kg/t)	109.0		Methanol	3625.8		262.7		4.2	
			Subtotal	5757.7		380.8		6.1	
<b>Distribution</b>			<b>Distribution</b>						
Ro und-trip distribution of bd (km)	450		diesel fuel vehicle	409.4		31.0		6.8	
			Subtotal	409.4		31.0		6.8	
			<b>GRAND TOTAL</b>	<b>16359.8</b>		<b>1532.0</b>		<b>119.3</b>	
*Based on the LCA work of Sheffield Hallam University									
							<b>Summary</b>		
							<b>Cultivation</b>		
							[MJ/t.bd]	[kg.eq.CO2/t.bd]	[Euros/t.bd]
							5878	875	73.7
							<b>Transport, Drying, Storage</b>		
							[MJ/t.bd]	[kg.eq.CO2/t.bd]	[Euros/t.bd]
							1305	90	13.5
							<b>Solvent Extraction</b>		
							[MJ/t.bd]	[kg.eq.CO2/t.bd]	[Euros/t.bd]
							2460	123	5.1
							<b>Refining</b>		
							[MJ/t.bd]	[kg.eq.CO2/t.bd]	[Euros/t.bd]
							462	28	1.0
							<b>Esterification</b>		
							[MJ/t.bd]	[kg.eq.CO2/t.bd]	[Euros/t.bd]
							5758	381	16.1
							<b>Distribution</b>		
							[MJ/t.bd]	[kg.eq.CO2/t.bd]	[Euros/t.bd]
							498	35	10.0
							<b>GRAND TOTAL per tonne bd</b>		
							[MJ/t.bd]	[kg.eq.CO2/t.bd]	[Euros/t.bd]
							16360	1532	119.3
							<b>End Use per 100 km</b>		
							[MJ input/100 km]	[Euros/100 km]	
							0.87		
							<b>MJ input per MJ.bd</b>		
							[MJ input/ MJ.bd]	kg.eq.CO2/MJ.bd	Euros/ MJ.bd
							0.4398	0.0412	0.0032