MANAGEMENT OF RECOVERED WOOD: STRATEGIES TOWARDS A HIGHER TECHNICAL, ECONOMICAL AND ENVIRONMENTAL STANDARD IN EUROPE,
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WHAT IS COST AND COST ACTION E31 "MANAGEMENT OF RECOVERED WOOD"

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ABSTRACT

The COST (European Co-operation in the Field of Scientific and Technical Research) Action E31 (2002 to 2006) is a multi-disciplinary forum for the exchange of information on "Management of Recovered Wood" with the main objective to improve the European management of recovered wood towards a higher common technical, economic and environmental standard (http://www.ctib-tchn.be/coste31). Researchers of 21 European countries – Austria, Belgium, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Rumania, Serbia-Montenegro, Slovenia, Spain, Sweden, United Kingdom - are involved in the Action, which is subdivided in 2 Working Groups:

1) *European management of recovered wood: analyze the current systems of wood recovery in Europe, i.e. technical and legal aspects, environmental impacts, recovered wood potential*
2) *Treatment options for recovered wood: Analysis of different current and future*

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treatment options for recovered wood based on technical, economic and environmental criteria.

The most important first activities and results are achieved in recent activities in the 1st COST E31 Conference and joint workshops between the two working groups and with otherEuropean and international networks, e.g. other COST Actions, IEA Bioenergy and InnovaWood. The most relevant findings of importance for recovered wood are

- *market aspects of recycling versus energy generation,*
- *available amounts and assortments of recovered wood,*
- *characteristics, standardisation and limits of recovered wood as input material for particle boards and emissions of combustion for energy generation,*
- *developing long term strategies for increasing amount of available recovered wood and*
- *new options for the use of recovered wood e.g. blue mulch, food, feed, bricks, transportation fuels.*

Keywords: *waste wood, recovered wood, wood treatment options.*

INTRODUCTION

What is COST?

Founded in 1971, COST is an intergovernmental framework for European CO-operation in the field of Scientific and Technical Research, allowing the co-ordination of nationally funded research on a European level. COST Actions cover basic and pre-competitive research as well as activities of public utility. The goal of COST is to ensure that Europe holds a strong position in the field of scientific and technical research for peaceful purposes, by increasing European cooperation and interaction in this field.

COST has clearly shown its strength in non-competitive research, in pre-normative cooperation and in solving environmental and cross-border problems and problems of public utility. It has been successfully used to maximise European synergy and added value in research cooperation and it is a useful tool to further European integration, in particular concerning Central and Eastern European countries. Ease of access for institutions from non-COST Member States also makes COST a very interesting and successful tool for tackling topics of a truly global nature.

To emphasise that the initiative came from the scientists and technical experts themselves and from those with a direct interest in furthering international collaboration, the founding fathers of COST opted for a flexible and pragmatic approach. COST activities have in the past paved the way for Community activities and its flexibility allows COST Actions to be used as a testing and ex-

ploratory field for emerging topics.

The Member States participate on an "à la carte" principle and activities are launched on a "bottom-up" approach. One of its main features is its built-in flexibility. This concept clearly meets a growing demand and in addition, it complements the Community programmes.

COST has a geographical scope beyond the EU and most of the Central and Eastern European countries are members. COST also welcomes the participation of interested institutions from non-COST Member States without any geographical restriction.

COST has developed into one of the largest frameworks for research cooperation in Europe and is a valuable mechanism coordinating national research activities in Europe. Today it has almost 200 Actions and involves nearly 30,000 scientists from 34 European Member States and more than 80 participating institutions from 11 non-COST Member States and Non Governmental Organisations.

In total, institutions from 46 countries participate in COST under different forms:

34 Member States: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, Serbia and Montenegro, Former Yugoslav Republic of Macedonia and Israel as Cooperating State.

COST has a geographical scope beyond the EU. Institutions from non-COST countries may join COST Actions. In 2003, there were institutions from the following countries: Algeria (1), Argentina (1), Australia (4), Canada (18), China (Macao) (2), Eritrea (1), India (1), Japan (4), Russia (15), Ukraine (8), USA (16) and also 7 participating Non Governmental Organisations (NGO).

COST is based on Actions. These are networks of co-ordinated national research projects in fields, which are of interest to a minimum number of participants (at least 5) from different Member States. The Actions are defined by a Memorandum of Understanding (MoU) signed by the Governments of the COST states wishing to participate in the Action. The duration of an Action is generally 4 years.

The increasing number of COST Actions of currently 180 and 50 in the starting phase proves the success of COST within the European Scientific Community. The participation of the various countries in COST actions is shown below. In general the participation over the Member States appears to

be evenly distributed. No significant change in this distribution has taken place over the last several years.

COST covers a wide range of scientific and technological domains. At present there are 15 domains, that cover a wide range of different disciplines, e.g. forests and forestry products, physics, material.

Funding COST represents an estimated volume of national funding of more than € 2.0 billion per year. This funding is basically used to cover coordination costs such as contributions to workshops/conferences, travel costs for meetings, contributions to publications and short term scientific missions of researchers to visit other laboratories.

Background of COST Action E31

The European Union has set a target to double the share of renewable energy in the European primary energy supply from a level of 6% in 1997 to 12% by 2010. The positive technical, economic and structural conditions for the use of biomass for energy generation will enable biomass to contribute significantly to this aim.

In the Kyoto process the European Union has committed to reduce European greenhouse gas (GHG) emissions (CO_2, CH_4, N_2O etc.) by 8% from 1990 level by the year 2010. Energy generated from biomass is able to substitute for fossil fuels used for electricity, heat supply and transportation fuel. Biomass

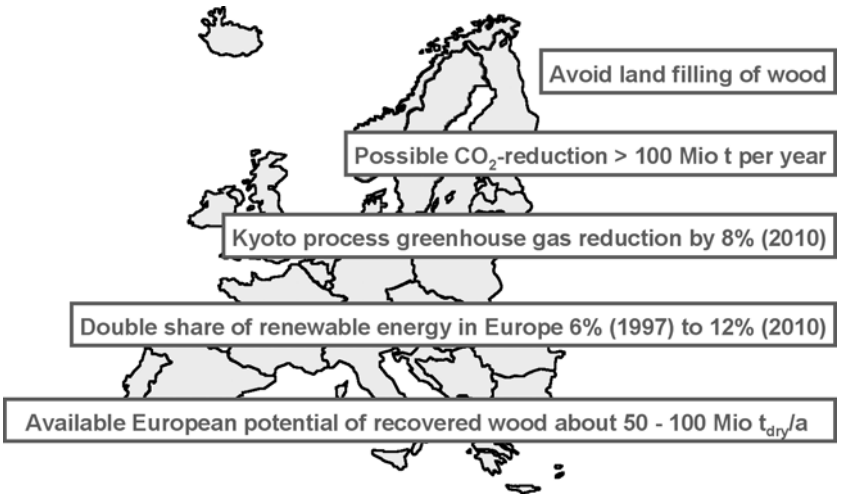

Figure 1. *Background of COST Action E31 "Management of Recovered Wood".*

will therefore contribute substantially to the reduction of greenhouse gas emissions, mainly CO_2 from fossil fuel combustion.

Landfilling of organic material leads to CH_4 emissions, and the GHG potential of CH_4 is 21 times higher than that of CO_2. Therefore, avoiding landfill of biomass can reduce CH_4-emissions from landfill sites. One of the most important sources of biomass – in addition to forestry and energy crops - derives from industrial wood at the end of its life (e.g. demolition wood, timber from building sites and the commercial sector). As shown in Figure 1 this is the background and motivation of this COST Action E31.

Scope of Recovered Wood in COST Action E31

Recovered wood covered by the scope of COST E31 includes all kinds of wooden material that is available at the end of its use as a wooden product ("post-consumer" or "post-use" wood). Beside forest residues and energy crops, recovered wood is one of the most important renewable sources of biomass and as a renewable raw material and energy carrier. Recovered wood mainly comprises packaging materials, demolition wood, timber from building sites and fractions of used wood from residential, industrial and commercial activities (Figure 2).

Therefore all wood grades from forestry residues including tops, thinnings and branches from forest operations are excluded as they are not in the scope of COST E31. Black liqueur from pulp production is also not within the scope of COST E31.

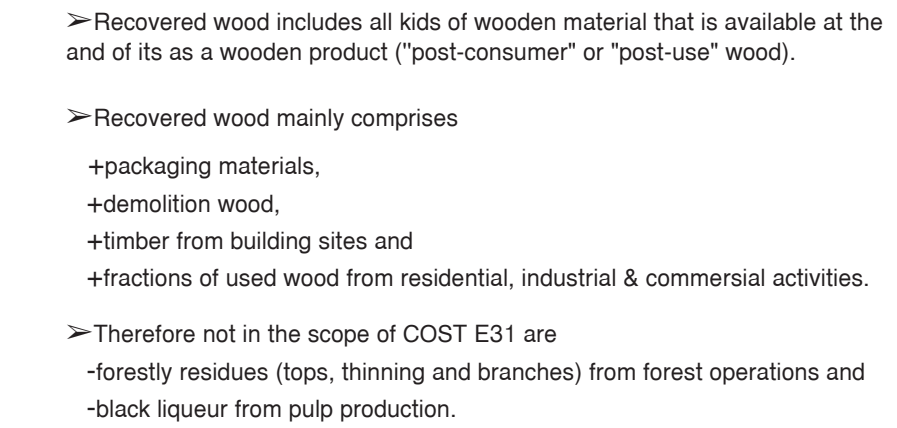

Figure 2. *What is recovered wood in COST Action E31 "Management of recovered wood".*

Recovered wood is described by the following origins: saw mill, wood manufacturing industry, particle board industry, pulp and paper industry, construction and demolition activities, residential and commercial sectors, packaging (Figure 3). Whereas the COST Action E31 is mainly focusing on recovered wood from the wood utilization side, but including market interactions, market effects and future market developments with wood from the wood processing side.

The most important parameters describing recovered wood are size, quality properties, condition, heating value, moisture content, content of chlorine, ash, contamination and heavy metals (Figure 4).

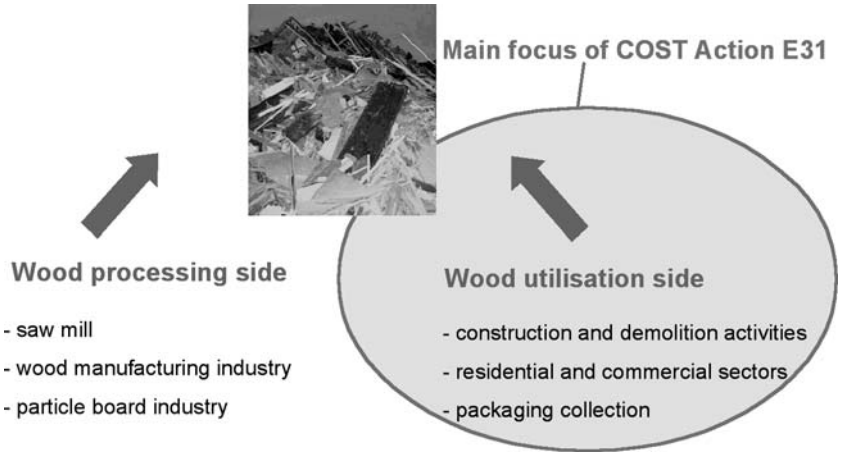

Figure 3. *Origins of recovered wood in COST Action E31 "Management of recovered wood".*

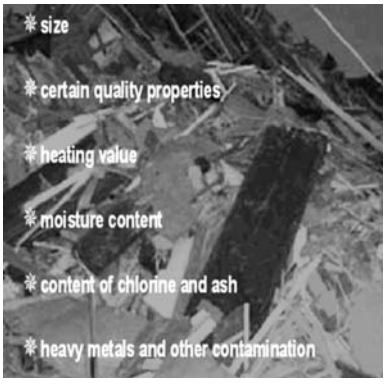

Figure 4. *Most important parameters of recovered wood.*

Management Options for Recovered Wood

The selection of a certain management option for recovered wood depends on a set of criteria, including quality and quantity of material, environmental burdens of recovered wood treatment, possible options for substitution for other energy carriers, infrastructure, technologies, legislation (driving force), costs and benefits and socio-economic and other factors. These criteria are strongly interdependent.

The most important management options for recovered wood are (Figure 5):

- o disposal
- o using wood as material (recycling as secondary raw material)
- o wood for energy use (energy generation)

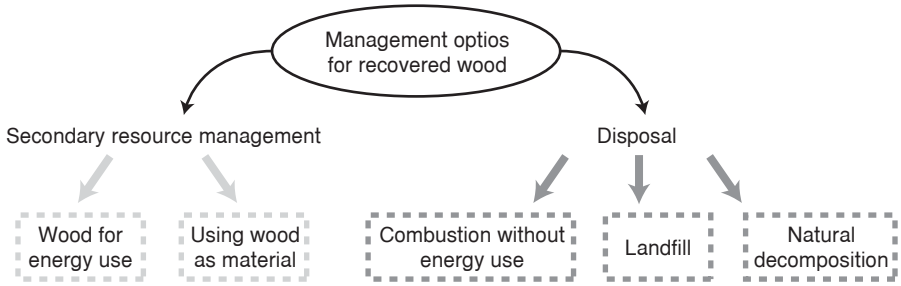

Figure 5. *Systems of management options for recovered wood.*

Disposal

Both of the most common recently used disposal strategies - 'landfill' and 'combustion without energy use' – fail to use effectively the material or energy properties of recovered wood. In fact, landfilling of biomass is known to be among the largest sources of climate-damaging methane gas (CH_4). Therefore, with recovered wood as one of the most important sources of biomass in landfills, avoiding this disposal route would reduce substantially CH_4- and GHG-emissions from landfill sites.

Tackling the emissions from landfills is only one important issue supporting moves towards an improved management of recovered wood in Europe. The extraction of recovered wood from industrial and municipal disposal can also provide a valuable secondary source of raw materials that can substitute either for primary raw material or fossil fuels. Creating a Europe-wide strategy to add environmental and economic value to recovered wood will help in the development of future systems designed specifically to give optimal benefits from a sustainable utilisation of forests, wood products and recovered wood.

Recycling

Recovered wood for industrial purposes is currently mostly used in the production of particleboard and fibreboard. Other possible utilisation options for recycling of recovered wood as a solid material are of minor significance. In order to provide appropriate consumer protection and to prevent the accumulation of hazardous substances, the recovered wood that can currently be used generally as a secondary raw material and in wood based panel production in particular has to be limited to the non-hazardous fractions. For those fractions of untreated and not contaminated recovered wood also trade (resp. shipment) can be stated within the European internal market. E.g. a particleboard mill in Portugal covers a considerable part of its demand on raw material with recovered wood transported from Eastern Germany via Baltic and North Sea.

Energy Generation

The estimation of 50 - 100 Mio. tons of recovered wood in Europe has an energy content of about 750 – 1,350 PJ, depending on its moisture content. Thus, the use of recovered wood for energy generation could contribute significantly to two major policy goals of the European Union. On the one hand, such use would contribute to doubling the share of renewable energy in the European primary energy supply to 12% by 2010 and on the other hand, being a virtually CO_2 neutral energy source, it would help meet the reduction of EU greenhouse gas emissions as declared within the Kyoto process. The substitution of coal with the above amount of recovered wood could lead to a reduction of 75 – 135 Mio tons of CO_2 per year.

Objectives of COST Action E31

Topics of Interest

The main objective of this Action is the improvement of the management of recovered wood towards a higher common technical, economic and environmental standard (Figure 6) by focusing on the following general items

- o analysis of management approaches for recovered wood in Europe
- o examine potentials of recovered wood as secondary raw material and energy source
- o improvement of databases on technical, economic, environmental and statistical information
- o identify promising approaches for implementation of advanced systems for the management of recovered wood.

To advance the management of recovered wood significantly on a European level, this Action aims to take into account in particular the following specific issues:

- o further enhancement of the integration of the management systems for recovered wood
- o examination of the technical potentials of recovered wood and wood residues as both secondary raw materials and as energy sources
- o improvement of the quality of the European databases on the technical, economical and statistical information for recovered wood and its potential
- o analysis of all different management approaches for recovered wood in all the European countries to establish a reliable basis for strategic decisions
- o broadening of the knowledge basis and improvement of assessment procedures to advance the common understanding and to promote the development of appropriate wood recovery systems at the European level to optimise the use of wood resources
- o further development of methodologies including the analysis of different recovered wood management systems to achieve an integrated, common description of the recovered wood management sector in the different European countries
- o enhancement of the systems for the collection of technical, economic and statistical data concerning the different recovered management systems, and on the quantities and qualities of recovered wood
- o improvement of the methods to monitor the implementation of new systems for the management of recovered wood to avoid landfilling and through the supply of sustainable energy
- o expansion of the knowledge base on current recovered wood management as well as the available qualities and quantities of recovered wood to support the technical development of further possibilities to use recovered wood in (new) materials and products.

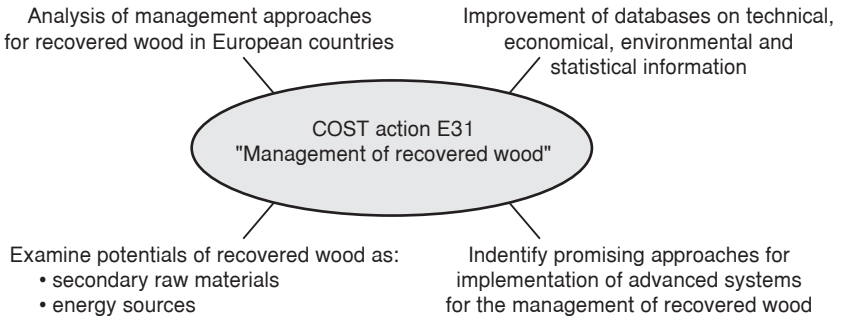

Figure 6. *Objectives of COST Action E31 "Management of recovered wood".*

Approach

Researchers of 21 European countries – Austria, Belgium, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Rumania, Serbia-Montenegro, Slovenia, Spain, Sweden, United Kingdom - are involved in the Action, which is subdivided in 2 Working Groups (WG):

1. European management of recovered wood: analyse the current systems of wood recovery in Europe, i.e. technical and legal aspects, environmental impacts, recovered wood potential
2. Treatment options for recovered wood: Analysis of different current and future treatment options for recovered wood based on technical, economic and environmental criteria

Cross-sectoral and multi-disciplinary exchange of knowledge originating from ongoing research activities in Europe is an important aim of all COST Actions. In COST Action E31 specific cross-sectoral LCA topics in the recovered wood sector (particleboard industry, wood industry, energy sector industry, recovered management sector) will be addressed. To cover the topics listed below working groups will be established. Because of the fast developing nature of this science, there is also a need to bring experts in particular areas together for intensive development sessions. These activities will be co-ordinated by the management committee of the COST Action.

Two workgroup areas have been identified, in which further task groups might be set up during the life span of the action if necessary. The results of Working Group 1 and Working Group 2 have to be combined in order to create a pattern that will allow for any particular case selection of the optimum recovered wood treatment option. Intensive workshops, multi-disciplinary seminars engaging the whole action are particularly essential for this outcome. Also

Figure 7. *Working Triangle in COST Action E31 "Management of recovered wood".*

future prospects and recommendations to political, economical and institutional decision-makers shall be results of this effort (Figure 7).

Scientific Innovation and Relevance

The scientific innovation and relevance is reflected by the following topics, that will appear as final outcome of this COST action E31:

- o development of new methods including guidelines for the management of recovered wood
- o improvement of the methods to evaluate existing and possible new treatment options for wood recovery
- o improvement of the methods to generate energy from recovered wood
- o development of a common method for technical, economic and environmental comparison of different recovered wood treatment options
- o improvement of the methods to assess the use of recovered wood in (new) materials and products
- o investigation of possibilities to increase the use of wood recovered as a secondary material
- o development of methods to improve the data collection concerning the (regional) amount of recovered wood taking into consideration the different collection systems and treatments applied to wood recovery.

WORKING GROUP 1: EUROPEAN MANAGEMENT OF RECOVERED WOOD

The main task of Working Group 1 is to analyze the current systems of wood recovery in Europe. This needs to address the technical, legal and environmental aspects and impacts of management schemes for recovered wood used in the different European countries including the recovered wood potential and the choice of recovered wood treatment option (Figure 8) by analyzing the following items

- o analysis of the management systems for recovered wood in Europe (flows, treatment, current conditions and situations..): for a reliable determination of total volume of recovered wood and its different components (residues, waste etc.) including future projections
- o logistic/infrastructure (transport, sorting, collection, dismantling etc.): analysis of recent collection logistics, transportation characteristics; public versus private recovered wood management
- o legislation: European legislation and difference in implemented subsidiary measures at the Member State level, definition of recovered wood

characteristics, their duration and their particular application on the wide range of recovered wood types; precise definitions and standards that have to be met by a recovery measure
- o analysis of the market conditions: landfill fees, energy prices, price for fresh wood
- o definition of recovered wood: classification of industrial and forest residues, waste nomenclature: development of recovery compatible and harmonised recovered wood categories
- o systems in use
- o forecast and recommendations for future development
- o socio-economic factors: public opinion, employment, tradition, comfort, etc.

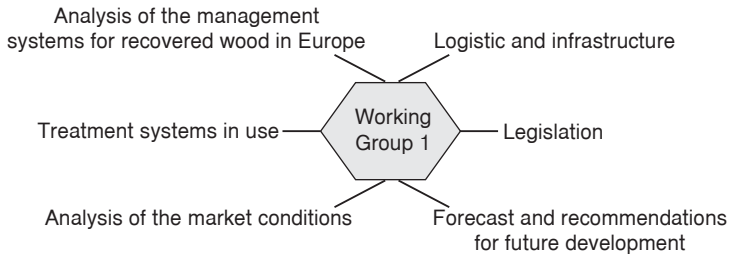

Figure 8. *Objectives of Working Group 1 "European management of recovered wood".*

WORKING GROUP 2: TREATMENT OPTIONS FOR RECOVERED WOOD

The main task of Working Group 2 is to analyse different current and future treatment options for recovered wood based on technical, economic and environmental criteria (Figure 9) by focusing on the following items

- o energy generation, recycling and landfill of recovered wood
- o technologies for energy generation
- o environmental effects (ash, air emissions etc.): environmental burdens of the different recovered wood treatment options; definitions and standards for environmentally sound recovery technologies; examination of the conditions under which the energy input in the recovery or recycling of recovered wood leads to a higher environmental value; comparison of energy supply based on different energy sources, substitution modelling; prevention of contaminating substances accumulation in closed substance cycle (recycling) coming from (hazardous) impurities in recovered wood
- o economic and socio-economic parameters, costs: examination of the con-

ditions under which the energy input in the recovery or recycling of recovered wood leads to a higher economical value; substitution effects (e.g. fossil fuels) and economic balance for the employment of recovered wood compared with fresh wood or other (fossil) energy sources in the relevant technical processes
- o design of wood products and end-of-life product management
- o state-of-the-art technology for wood recovery and treatment including the prospects for and elaboration of technological standards for energy recovery: emission limits, energetic efficiency factor, use of the generated heat, treatment of remaining residues
- o internalisation of environmental costs and their impact on the market, e.g. new European landfill directive governs that all costs of landfill (incl. after care and land restoration cost) must be included in the collection price.

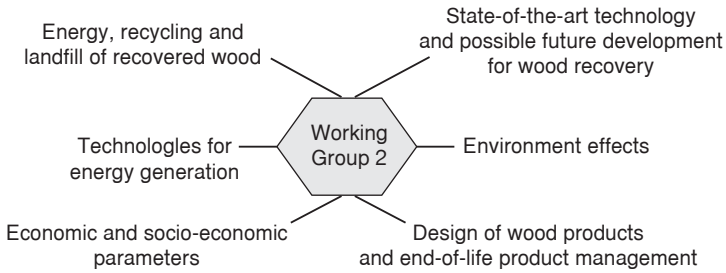

Figure 9. *Objectives of Working Group 2 "Treatment options for recovered wood".*

Benefits

The following benefits are expected from this COST Action E31 (Figure 10)

- o bring together a multi-disciplinary and multi-cultural 'team' discipline under one umbrella
- o establish a European forum for the management of recovered wood
- o give a comprehensive overview of the different management options for recovered wood
- o give an overview on available data and stimulate new data acquisition on the different recovered wood assortments in Europe
- o expand the relevant data base
- o provide strategic information for various stakeholders
- o mobilize additional biomass as a sustainable energy source

- o advance the methodology for environmental, technical and economical evaluation of different recovered wood treatment options
- o develop tools for the comparison of different management options for recovered wood
- o initiate possible common proposals to European Community framework programs.

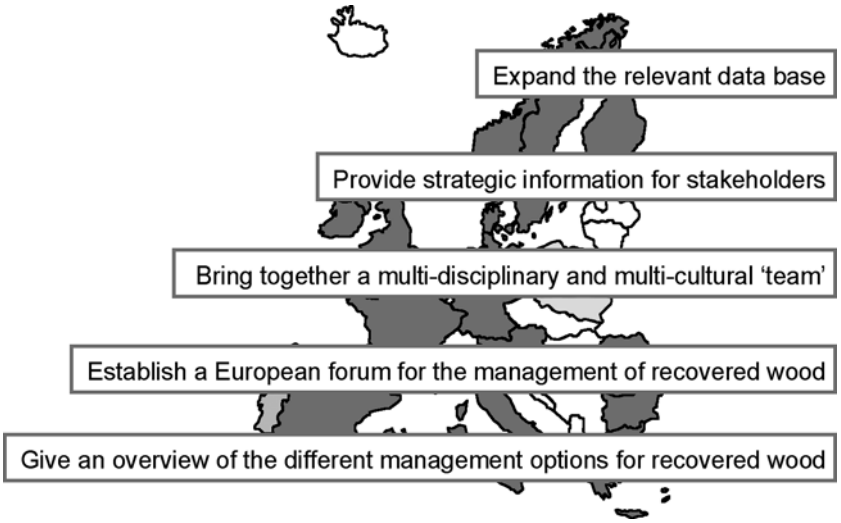

Figure 10. *Benefits of COST Action E31 "Management of recovered wood".*

FIRST RESULTS

The most important first activities and results are summarized, whereas the results of the 1st COST E31 Conference, of the several joint workshops with other European and international networks and of a training course on recovered wood are described.

1st COST E31 Conference

The 1st COST E31 Conference "Management of recovered wood – recycling, bioenergy and other options" took place on 22 – 24 April 2004, Thessaloniki in Greece. About 70 participants and speakers were involved in information and discussion about the following main topics.

- o Economy and markets for recovered wood
- o Management of recovered wood
- o Technologies for reuse, recycling and energy generation of recovered wood

- Environmental benefits and impacts of recovered wood

During the conference the following "hot" topics were identified as a special future focus of COST Action E31

- Market aspects: recycling versus energy generation
- Amounts and assortments of recovered wood (incl. terms and definitions)
- Characteristics, standardisation and limits of recovered wood as input material for particle boards
- Emissions of combustion for energy generation
- Developing long term strategies for increasing amount of available recovered wood
- New options for recovered wood: blue mulch, food, feed, bricks, transportation fuels

Joint Workshops

There were three joint workshops with other networks organized, with the aim to link common knowledge, expertise and initiate possible future activities.

- Joint workshop COST E31 and COST E37 "Sustainability Through New Technologies For Enhanced Wood Durability", 9 –10 February 2005, Antibes, France
- Joint workshop of COST Action E31 and IEA Bioenergy Task 38 "Greenhouse Gas Aspects of Biomass Cascading – Reuse, Recycling and Energy Generation", 25 April 2005 Dublin, Ireland
- Joint workshop of COST Action E31 and InnovaWood, 26 – 28 June 2005, Warsawa, Poland

The joint workshop with COST E37 focused on

- Environmental aspects of incineration of modified wood
- Markets for energy and non-energy use of wood after its service life
- Legislation and policy of wood as a source of energy
- Non-energy uses of wood at the end of its service life

The joint workshop with IEA Bioenergy was dedicated to exchange and discuss experience and recent activities on

- Biomass cascading
- Energy generation
- Reuse and recycling.

The joint workshop with Innovawood included beside a presentation of activities of each network a collection and discussion one common input for the European Forestry Technology Platform and decisions on the future common activities to link the different activities of both groups.

Training course

COST Training course are aiming to provide within the frame of an action topic for a group of scientists over a period of several days to maximum 2 weeks intensive training in a new emerging subject in one of the laboratories of the action with unique equipment or know how. The participants are basically but not exclusively young researchers from across Europe but should also cover appropriate re-training as a part of 'life-long learning.'

The training course "Management of recovered wood" took place on 7 – 11 June 2005 in Hamburg, Germany where about 20 people participated and 10 people gave lectures. The special main topics were:

- o Energy generation from recovered wood
- o Recycling of recovered wood
- o Scientific visit to energy generation and recycling of recovered wood.

The whole material is available on web: http://www.ctib-tchn.be/coste31

OUTLOOK

The remaining two years of COST Action E31 will be spent on working in the two working groups towards their final results and publications with the aim, to present most interesting results and recommendations on the final COST E31 conference that will take place in spring 2007.

For this work the motivation of COST Action E31 is reflected in the motto shown in Figure 11.

"Improvement of the management
of recovered wood
towards a higher common
technicall, economic and environmental standard"

Figure 11. *Motto of COST Action E31 "Management of recovered wood".*