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IEA Bioenergy is an international collaborative agreement set up in 1978 by the International Energy Agency (IEA) to improve international co-operation and information exchange between national bioenergy RD&D programmes. IEA Bioenergy aims to achieve a substantial bioenergy contribution to future global energy demands by accelerating the production and use of environmentally sound, socially accepted and cost-competitive bioenergy on a sustainable basis, thus providing increased security of supply whilst reducing greenhouse gas emissions from energy use.

Outgoing Chair Paul Grabowski and incoming Chair Kees Kwant.

To: IEA Headquarters, Paris

IEA BIOENERGY ANNUAL REPORT 2014

Under the IEA Framework for International Energy Technology Cooperation the Executive Committee of each Implementing Agreement must produce an Annual Report for IEA Headquarters.

This document contains the report of the IEA Bioenergy Executive Committee for 2014. This year, we have presented a special feature 'Quantifying the Climate Effects of Forest-Based Bioenergy: Dealing with spatial and temporal boundaries' prepared by Task 38.

The contributions from the Task Leaders and Operating Agents to this report are gratefully acknowledged.

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Further information on IEA Bioenergy can be obtained from the Executive Committee Secretary, see back cover of this Annual Report.

Quantifying the Climate Effects of Forest-Based Bioenergy: Dealing with spatial and temporal boundaries

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Summary

Bioenergy is a key strategy for climate-change mitigation, which is recognised in several domestic and international policies. However, over recent years, claims have been made that some forest-based bioenergy systems are associated with losses in biospheric carbon (sometimes referred to as forest "carbon debt") and, thus, their effectiveness at mitigating climate change has been questioned. Climate impacts of forest bioenergy are sensitive to a range of case-specific factors, but also methodological choices and assumptions: biomass feedstocks, reference energy system displaced, definition of spatial system boundary, allocation procedures, time horizon, metrics applied and climate forcers considered. In this feature, these key issues are briefly discussed and recommendations are provided for carrying out appropriate and comprehensive assessments of climate impacts of forest bioenergy systems.

Introduction

Bioenergy has been promoted as a component of climate-change policies in many countries; however, over recent years, the climate benefits of bioenergy systems have been questioned. Concern over the effectiveness of *agricultural* bioenergy for climate change mitigation is mainly related to indirect land-use change (ILUC) and the use of nitrogen fertilizers, while forest-based bioenergy has been challenged with claims that carbon losses from removal of biomass for energy from existing forests creates a 'carbon debt'. In the worst cases the magnitude of the carbon loss may be large enough to negate climate benefits from replacing the use of fossil fuels by forest-based bioenergy in the short to medium term. However, in the best cases the initial carbon loss, if any, may be paid back after a few years of displacing fossil fuels. As the short-term and long-term climate impacts may be significantly different for any specific case, the time horizon adopted can substantially influence the conclusions drawn.

This feature reflects on the issue of how to include the timing of greenhouse gas (GHG) emissions and carbon sequestration in the assessment of the climate-change impacts of forest-based bioenergy. We discuss the sensitivity of results to the setting of spatial and temporal boundaries, and the handling of co-production of wood products and bioenergy. Furthermore, the role of case-specific factors, non-GHG climate forcers, and the choice of metrics to measure climate impacts are considered. Finally, general recommendations are given for requirements for an appropriate and comprehensive climate impact assessment of forest-based bioenergy.

The forest carbon cycle

Sustainable bioenergy systems are commonly considered to be carbon neutral because the carbon that is released during combustion had previously been sequestered from the atmosphere and will be sequestered again as the biomass is regrown (Figure 1a). In the case of long- rotation forestry, this regrowth phase may take many decades. Forest biomass systems are effectively carbon neutral over time if the forest sequesters the same amount of carbon in the following rotation as was released, so that the long term average carbon stock remains constant. Nevertheless, the asynchrony between carbon emissions and sequestration, when considered on the basis of a single stand, has led to concerns that bioenergy does not necessarily deliver climate benefits in the short term: depending on the reference system adopted, during the period between combustion and regrowth there may be additional CO_2 in the atmosphere, causing a warming effect. However, this single-stand perspective does not necessarily provide adequate understanding of the climate effects of forest bioenergy.

Forest bioenergy as a part of forestry

The appropriate boundaries of the assessment are determined by the purpose of the investigation. For example, a policymaker may be concerned with the impacts at a regional or national scale, so assessments to inform policy development should take place at that broad scale. On the other hand, an individual forest owner may be interested in effects at the estate level. When the assessment is undertaken for the purpose of product labelling, the scale of analysis applies to the system that produces that product.

It is important to recognise that forest bioenergy is commonly a co-product of the forest industry, associated with the production of sawn and composite wood products, and paper. Biomass for energy may be derived from harvest slash (e.g. branches, tops, stumps) that would otherwise have decayed in the forest, or it may be obtained from mill residues (saw dust, shavings, etc.) or construction waste. End-of-life wood products are also a desirable source of biomass for energy, and allow the carbon sequestered by the tree to be stored for long periods while timber is in use, for example as a building material, prior to its use for energy. Biomass for energy tends to be a low-value product compared with sawlogs, and thus has traditionally not been the primary driver in determining forest management and harvest scheduling. Therefore, it is important to consider bioenergy within the context

of forest products markets. On the other hand, ambitious targets to increase the use of bioenergy, for example in certain European countries, may make the direct use of round wood for energy more common. Thus, the increase in forest bioenergy utilisation does not necessarily come from industrial co-products, which is also important to recognise.

Forests managed for timber production consist of a mosaic of stands of different ages: the objective of forest management is to generate a continuous supply of forest products, so stands are harvested sequentially. Therefore in an ideal "normal" forest, across the forest estate, the carbon losses at harvest are balanced by gains in the growing stands, so carbon stock of the whole forest is stable (Figure 1b). The average carbon stock across the estate reflects the net effects of forest growth (influenced by climate and soil), forest management (that is, site preparation, planting, fertilising, thinning, pruning and harvesting), and natural disturbances such as fire, windthrow and insect outbreaks. When a new harvest regime is introduced, this will be imposed sequentially as each stand is harvested. If the average carbon stock is different under the new regime, a new equilibrium will be reached after one rotation period. While a new forest management regime that extracts more biomass for bioenergy could reduce the carbon stock in the forest, this "GHG cost" (see Figure 1) can be minimised by management practices that enhance growth and thus accelerate C uptake, such as improved site preparation, superior genetic material and forest fertilization (illustrated by the purple curves in Figure 1b and c). Where there is an increased demand for bioenergy and forest products, forest managers may choose to invest in intensified forest management to enhance growth rates, and modify harvest schedules, which may increase or decrease total forest carbon stocks compared to the case without bioenergy demand.

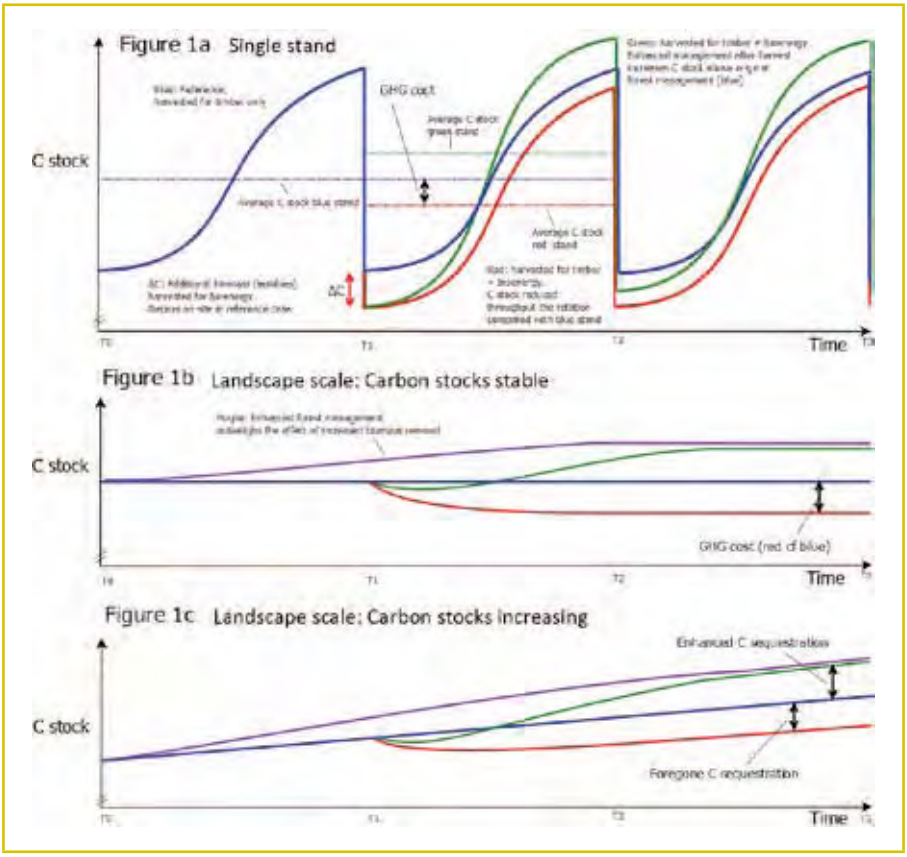

Figure 1 shows simplified representations of the carbon stocks in a managed forest. It does not show changes in rotation period nor the carbon stock fluctuations around these simplified curves caused by climate variation and forest operations, such as thinning. Figure 1a shows the carbon stock (sum of carbon in trees, soil and litter) of an individual stand, over successive rotations. The blue curve shows the reference scenario, a forest harvested for timber only. The other curves show two alternative scenarios, in which harvest residues (branches and tops), usually left in the forest, are removed for bioenergy at harvest, at time T1 and each successive harvest. The concept of "GHG cost" is illustrated in the red curve: the average carbon stocks are lower compared with the blue stand, due to removal of harvest residues, and, possibly, flow-on effects on soil carbon stocks and forest growth rate. In practice, the GHG cost also includes emissions from any fossil fuel used in the feedstock production, energy conversion and distribution. The green curve illustrates how enhanced forest management can reduce the GHG cost. Figures 1b and 1c show the total carbon stocks summed across a landscape of multiple stands at different stages in the rotation cycle, assuming that all stands follow either the blue, red or green curves from Figure 1a. In reality, the forest carbon stock on the landscape level will reflect a mix of different management approaches applied to different stands, which may include adjustment to the rotation period. An additional curve, in purple, shows a scenario where changes in forest management across the forest landscape outweigh the effect of increased biomass removal for bioenergy, so that the forest carbon stock increases on landscape level. Figure 1c shows a situation where the carbon stocks across the landscape are increasing, such as where the national estate is dominated by young stands; over time, the total carbon stocks increase as these stands mature. Although the total stocks continue to increase in all scenarios in Figure 1c, biomass removal can lead to "foregone sequestration" (red curve), though this can be reduced or avoided through enhanced forest management (green and purple curves). Note that the net GHG-mitigation potential of associated bioenergy systems also depends on the GHG displacement efficiency; i.e. a bioenergy system that is associated with declining forest carbon stocks (red curve) can deliver higher GHG mitigation than another bioenergy system that is associated with increasing forest carbon stocks (green or purple curves) if the latter has much lower GHG displacement efficiency.

Source: Cowie et al., 2013.

Bioenergy in national greenhouse gas inventories

According to the IPCC guidelines for national GHG emission reporting, CO_2 emissions from the combustion of biomass are counted as zero in the Energy sector. This is to avoid double counting, because CO_2 emissions from the harvest of forest biomass for energy are included in the Agriculture, Forestry and Other Land-Use (AFOLU)[1] sector. Consequently, if all countries follow the IPCC guidelines and report to the UNFCCC, all emissions from the use of biomass for energy will be estimated and reported (IPCC 2014a). However, under the Kyoto Protocol to the UNFCCC only developed ("Annex I") countries have commitments, and are required to account for their emissions against agreed targets. Developing countries do not have commitments, and any decline in forest carbon associated with harvest for biomass that is exported to Annex 1 countries from non-Annex 1 countries is excluded from accounting. Furthermore, reporting changes in forest carbon stock was optional for Annex I countries in the first commitment period (2008-2012), so forest carbon losses from biomass harvest in Annex I countries was excluded by most countries. There was limited incentive to enhance forest carbon stocks due to national caps on forest sinks. These deficiencies have been partly addressed in the second commitment period of the Kyoto Protocol (2013-2020), as accounting for "forest management" is now mandatory. However, forest management emissions and removals are accounted relative to country-specific, projected reference levels representing the 'business as usual' baseline. Consequently, harvesting of biomass may or may not create a debit, depending on the overall development of C stock and the agreed forest reference level. It should be noted that not all developed countries are committed to the Kyoto Protocol and that the commitments have been defined only until 2020 so far. The rules applied to forests and bioenergy under future commitments may change, which would influence the effectiveness of bioenergy in contributing to future targets for emissions reduction and forest sinks.

Quantifying the climate effects of forest bioenergy

Considering the scientific knowledge basis and the open international climate policy framework in the long term, the critical questions for policymakers should be: will bioenergy incentives result in a positive, negative or neutral influence on the atmospheric GHG concentrations, and how this is influenced by changes in forest carbon stocks (at the landscape scale)? First, the answers vary due to case-specific factors, for example between different locations and due to variation in environmental and socio-economic factors. In addition, the change in forest management and harvesting regimes due to bioenergy demand depends on forest type, climate, forest ownership and the character and product portfolio of the associated forest industry. Furthermore, the forest carbon stock response to changes in forest management and harvesting in turn depends on the characteristics of the forest ecosystem.

[1] Formerly the emissions and removals from forestry were reported in the Land Use Land Use Change and Forestry (LULUCF) sector, which was separate from the Agriculture sector.

The climate effects of bioenergy may be quantified with life cycle assessment (LCA) (see Box 1). Unlike national GHG emission reporting and accounting, which focusses on annual emissions and removals, LCA, as indicated by the name, focusses on the entire life cycle of a system studied (a product, process, decision etc.). The climate effects of forest bioenergy systems depend on a number of factors related to raw material harvesting, transportation, storage and conversion, and final fuel storage, distribution and use. Different amounts and types of energy and other inputs, such as fertilizers and processing chemicals are used in different bioenergy systems. In addition, biomass harvesting influences forest carbon stocks, surface albedo properties, and possibly cloud formation and reflectivity. Biomass storage may cause process emissions. Finally, when biomass is used in place of fossil fuels, GHG emissions associated with the displaced energy system are avoided. Displacing coal achieves greater GHG savings than displacing the same energy content of natural gas, because coal is a more GHG-intensive fuel. However, the actual displacement effect is determined by market-mediated forces. The mitigation value is determined by the net effect of avoided emissions and the "GHG cost". GHG costs arise from emissions from fossil-fuel use along the supply chain, and any decline in the equilibrium C stock of the forest due to biomass harvest.

Box 1

Life cycle assessment (LCA) is a general framework for assessing any environmental impacts of product systems and decisions. The critical and interactive steps in LCA are 1) goal and scope definition, 2) life cycle inventory analysis (LCI), 3) life cycle impact assessment (LCIA), and 4) interpretation of the results. The results of LCA are expressed per functional unit (e.g. one MJ of bioenergy; 1 km driven by standard passenger vehicle under standard conditions). Thanks to the flexibility of the framework, LCA is suitable for small and large-scale product systems, and can be used to aid micro and macro level decisions (EC-JRC-IES 2010). LCA has been categorised into two main modelling techniques, namely attributional LCA (ALCA) and consequential LCA (CLCA). Generally, ALCA is defined by its focus on describing the environmentally-relevant physical flows to and from a life cycle and its subsystems (Finnveden et al. 2009; Curran et al. 2005). In contrast, CLCA aims to describe how environmentally relevant physical flows would respond (or would have responded) to a change (Finnveden et al. 2009), e.g. a decision to increase production of forest bioenergy. ALCA describes the environmental impacts of an artificially-truncated system, whereas CLCA aims to answer the question "what happens if?". Average data are applied in ALCA, whereas marginal data are applied in CLCA (Finnveden et al. 2009). Where a product is derived from a system with several outputs or functions, a method must be used to handle the impacts related to all products. Allocation (e.g. based on energy content, mass or value) is used in ALCA to solve multi-functionality, whereas allocation is avoided in CLCA by expanding the system to include products displaced by the co-product. Regardless of the modelling approach chosen, LCA fundamentally aims to describe the environmental impacts of a studied system. However, the system boundaries and other methodological choices, such as allocation and metrics applied in LCIA, vary depending on the goal and scope of the study.

To quantify the climate effects of bioenergy, the bioenergy system must be compared with a reference system that includes the alternative use of the forest, as well as the alternative energy source that is displaced by the bioenergy system. The definition of the "without bioenergy" reference scenario (or counterfactual), against which the bioenergy scenario is evaluated, is critical to the results. As with the bioenergy system, it is important to consider both management and natural factors in describing the forest carbon stocks in the reference system. This reference scenario may include forest management for a different mix of products and services, or preserving the forest for conservation. In assessing foregone sequestration, it should be recognized that sequestration rate slows as forests approach maturity, and that forests managed for conservation alone may have increased risk of disturbance, such as wildfire. Due to uncertainties, especially those related to future systems, it may be relevant to consider several alternative reference scenarios.

If the GHG cost is lower than the fossil-fuel emissions avoided by the bioenergy system, there will be an immediate benefit. This could be the case when forest residues are harvested and effectively used to substitute fossil fuels (e.g. Agostini et al. 2013, Matthews et al. 2014). If the forest carbon stock is significantly reduced, there may be a delay until the savings from avoided fossil fuel emissions lead to a net reduction in atmospheric CO_2 (e.g. Hudiburg et al. 2011); and the temporary increase in atmospheric CO_2 will cause global warming. This is typically the situation when growing trees are harvested for energy, as harvesting results in the immediate release of C previously stored in trees, and also in foregone C sequestration if trees would have continued to grow (Agostini et al. 2013, Matthews et al. 2014). Also, in some situations, in particular in landscape level analysis, the overall forest carbon stock may increase, but at a slower rate compared to the absence of harvesting for bioenergy; bioenergy is in this case also associated with foregone carbon sequestration, which should be taken into account when evaluating the net GHG effect (e.g. Kallio et al. 2013, Sievänen et al. 2014). It should be noted that the conversion efficiency of biomass to bioenergy greatly affects the GHG cost. For example, conversion of biomass to bio-liquids, while increasing the energy density and improving the properties for storage, is often less energy efficient than direct combustion of biomass for heat or power. The GHG cost is also influenced by the assumption/choice of feedstock displaced (e.g. coal is more GHG intensive than natural gas). While the forest C stock remains at a dynamic equilibrium, the substitution of fossil fuels is cumulative; the choice of time horizon for the assessment has a significant impact on the results and could even turn around the conclusions drawn.

As bioenergy and wood products are interrelated industries, a full understanding of the impacts related to forest bioenergy requires understanding also of the impacts related to industrial wood use. A strategic and rationalised cascading use of biomass, first for materials and subsequently for energy, allows for higher GHG benefits through multiple substitutions compared with direct use of newly harvested wood for energy (Pingoud et al. 2010, Gustavsson et al. 2006). In addition, GHG savings from substituting other materials by wood materials may be significantly larger than substituting fossil fuels by bioenergy (Sathre and O'Connor 2010). However, the various possibilities of wood use, as well as the complexity of identifying the displaced construction material, make it difficult to accurately quantify the GHG savings from substitution by wood products.

In addition to the impact from emissions and sequestration of GHGs, bioenergy systems can affect climate through additional forcing processes, including direct impact on albedo

(e.g. Georgescu et al. 2011; Loarie et al., 2011). Harvest of forests in high latitudes or altitudes with snow cover can increase albedo, reducing global warming (Bright et al., 2013). In some circumstances this effect is substantial, even counteracting negative impacts of a reduction in forest carbon stock (Bright et al. 2011). However, according to Spracklen et al. (2008) boreal forests double regional cloud condensation nuclei concentrations through emission of organic vapours and the resulting condensational growth of newly formed particles, having a significant cooling impact. Thus, harvesting of boreal forests reduces this cooling impact (thereby increasing warming), which compensates partly or completely the cooling impact of increased surface albedo. It should be noted that the knowledge gaps and uncertainties related to the complex interrelations between biogeochemical and physical climate forcings of forestry are still large (Bonan 2008, Anderson et al. 2010, Spracklen et al. 2008). Bioenergy systems may also influence climate through emissions of aerosols, or black carbon, in different ways, depending on the technologies and scenarios considered (Kupiainen & Klimont 2007).

Comprehensive assessment of the short- and long-term climate effects from expansion of bioenergy systems requires a consequential modelling approach that considers the land, forest products, energy sectors, as well as socio-economic and biogeophysical effects. This is necessary in the development of policy to inform decisions on appropriate scales of expansion of bioenergy systems and optimal use of biomass for competing energy and material products. When considering single bioenergy systems in the prevailing or assumed economic conditions, independent from market responses, an attributional modelling perspective may be more appropriate than consequential modelling. In this case, market-mediated effects are excluded (see Box 1). Examples of such cases might be the calculation of the carbon footprint of a bioenergy product to assess compliance within a scheme, or to label a product.

Does time matter?

Conventionally in LCA the timing of emissions and removals is not considered: the carbon footprint of a product is calculated by summing the emissions over the entire life cycle (e.g. ISO 2013). Some protocols exclude emissions occurring after more than 100 years, or quantify such long-term emissions in a separate category (e.g. BSI 2011). The implication is that timing of emissions and removals has no impact on climate change outcomes, which is known as a typical modelling error in LCA (Huijbregts 2001). In contrast, many current climate change policies provide incentives to delay emissions or sequester carbon temporarily. The justification for such policies is that they "buy time" that could allow society to develop and deploy low-carbon energy systems, and that they could assist in avoiding "climate tipping points".

However, the timing and irreversibility of such tipping points are uncertain (Collins et al. 2013). Furthermore, to achieve equilibrium temperature targets, the exact timing of CO_2 emissions and removals may not be the most important consideration; rather, to mitigate climate change the most important action is to restrict the cumulative total GHG emissions in the longer term (Collins et al. 2013). The more ambitious is the stabilization target (e.g. 2˚C temperature increase), the deeper emission cuts are required (Collins et al. 2013). Higher emissions in earlier decades imply lower emissions by the same amount later on (Collins et al. 2013). However, in the real world the short- and long-term

impacts are not typically independent from each other, due to relatively long economic lifetime of energy system structures (IPCC 2014b). Consequently, it is likely that achieving a 2˚C target in practice will require emissions to peak very soon, with deep cuts in emissions in the following decades (Collins et al. 2013, IPCC 2014b). Furthermore, as the climate sensitivity to the increasing GHG concentrations is not well known, the hedging of climate sensitivity risk calls for deeper early reductions instead of postponing the reduction measures (Ekholm 2014).

When assessing the effectiveness of bioenergy in climate change mitigation, the timing of the emissions and sequestration matters, depending on the given target and the resulting emission reduction window. For example, a forest bioenergy system causing more emissions than a fossil reference fuel in the beginning should possibly provide negative net emissions within the end of this century, in order to efficiently work in achieving the 2°C target (see Fig. 12.46a in Collins et al. 2013). Berndes et al. (2010) proposed "GHG emissions space" as a concept to encourage consideration of emissions management in the context of longer-term temperature targets. Focusing on the accumulated emissions up to a given year, society may decide to invest a portion of the emission space, allowed within the GHG target, on the establishment of renewable energy systems. Short-term emissions resulting from the establishment of bioenergy systems may be justified as investment in creating a low-carbon energy system. However, it should be noted that if a bioenergy system does not provide enough emission reductions within the given temporal window, which depends on the given climate change mitigation target, the "invested emissions" will need to be counteracted by other means. This may be difficult, especially considering the ambitious stabilization targets, which require that emissions from the whole society must be cut sharply within the upcoming decades.

Quantifying climate impacts due to timing of GHG emissions

When a pulse of CO_2 is emitted to the atmosphere a fraction of the CO_2 is taken up by the biosphere, some is dissolved in the ocean, and a fraction (15-40%) remains in the atmosphere for up to 2,000 years (Ciais et al. 2013). The climate effect of a pulse emission is quantified as the radiative forcing due to the perturbation. The commonly applied metric Global Warming Potential (GWP) quantifies the radiative forcing of a GHG pulse emission over a specified time period (commonly 100 years) in comparison with that of a pulse of CO_2 emitted at time zero.

Usually in LCA the GWP (100 years) is applied to calculate the CO_2 equivalent (CO_2-eq.) of non-CO_2 GHGs, and the climate effect is quantified as the total of GHG emissions and removals over the entire life cycle (e.g. ISO 2013) or over the first 100 years of the life cycle of a product (e.g. BSI 2011). Several authors have proposed alternative methods, for application in LCA, that do account for the timing of GHG emissions and removals (Brandão et al. 2013). Clift and Brandão (2008) developed the method adopted in the first version of the UK's carbon footprint guideline Publically-Available Specification for the assessment of the life cycle greenhouse gas emissions of goods and services "PAS2050" (BSI, 2008). Two more recent approaches, Levasseur et al. (2010) and Cherubini et al. (2011), are essentially equivalent to that of Clift and Brandão (2008). Levasseur et al. (2010) developed the "dynamic LCA" approach, which quantifies the radiative forcing resulting from an emission according to when it occurs within a defined

assessment period, and assigns a reduced impact if emissions are delayed within this period. Cherubini et al. (2011) proposed and Guest et al. (2013) demonstrated a method which quantifies the radiative forcing over the assessment period due to the combined effects of a pulse emission from combustion of biomass, followed by CO_2 removal due to the presumed regrowth. They apply a modified characterization factor "GWP_{bio}" that reflects this temporal profile of radiative forcing in comparison with a pulse emission of fossil CO_2, and varies with rotation length of the forest system. It should be noted that this metric does not aim to capture the forest carbon stock change between a bioenergy production scenario compared to a forest reference scenario without the studied bioenergy production, but rather it quantifies the climate effects of actual carbon emissions and the assumed subsequent sequestration. Thus, Pingoud et al. (2012) extended the "GWP_{bio}" concept to produce a metric that assesses the climate impacts in comparison to a reference system that includes the alternative use of the forest.

An alternative metric to GWP now gaining traction is the global temperature potential (GTP), which quantifies the effect of GHG emissions on the global temperature at a specified time (Myhre et al. 2013). GTP is thus more closely related than GWP to the impact of climate change on human and natural systems. Cherubini et al. (2013) assessed bioenergy systems and demonstrated that long-rotation forest systems show greater climate-change mitigation potential when assessed by GTP than by GWP.

Due to the dynamics related to biomass carbon emissions and sequestration, the time frame chosen to assess the climate impacts typically influences significantly the results. Furthermore, we should bear in mind that the pathway from GHG emissions to climate impacts goes through emissions, increased atmospheric concentrations, radiative forcing, temperature increase and other impacts (such as storms, droughts). Choosing the appropriate metrics depends finally on the goal and scope of the study. There is no one metric that gives the complete picture, thus it may be relevant to apply several metrics to improve understanding of the factors that influence the outcomes, and the sensitivity of results to alternative metrics. GWP (100 years) is still widely used in policy frameworks, but it is worth recognising that the preferred metrics might change.

Temporal boundary of assessment

Typically in LCA the assessment starts at the "cradle", which commonly includes raw-material extraction. In relation to bioenergy, it is debated whether the time period of assessment should commence when the forest was planted, or at the time of harvest. Fundamentally, this depends on the question posed. If the biomass is produced from reforestation undertaken to meet bioenergy demand, then the initial removal of CO_2 from the atmosphere as the plants grow before first harvest may be included as part of the bioenergy life cycle. In such a case, a decision to afforest is combined with a decision to harvest. However, what was considered optimal at some point in time (i.e. afforestation followed by harvest) is not necessarily optimal in the future (i.e. although originally planted for future harvest for bioenergy, it may be decided at the point of harvest that retaining the forest gives greater climate and other benefits). Thus, the impacts of the decision to harvest may also be of interest, independently of the prior decision to afforest and subsequently harvest. These two temporal boundaries probably result in very different conclusions. If the biomass is

extracted from existing forests, bioenergy is readily available, but choosing the appropriate time horizon for the assessment is challenging. If forest management is changed in advance of the first harvest as a consequence of bioenergy demand, then it may be appropriate to start the accounting clock at that time. An example of such a change is when forest owners choose to skip pre-commercial thinning in order to produce a larger bioenergy harvest in later thinning operations. On the other hand, it may be difficult to verify for what purpose the forests have previously been managed. Consequently, for existing forests the retrospective and prospective perspectives in accounting may be both relevant, as for biomass derived from afforestation or reforestation. Conclusively, the relevant temporal boundary depends on the purpose of the assessment.

Recommendations

It is proposed that, in order to understand the climate-change effects of forest-based bioenergy systems, it is important to define precisely the question to be answered and include the impacts of time. Additional recommendations include:

- consider bioenergy production in comparison to a reference system in which the assessed bioenergy is not produced;
- accurately define the reference forest management and energy systems with which bioenergy is compared and consider alternative reference scenarios whenever appropriate (typically there are uncertainties that need to be considered);
- consider whether stand or landscape level analysis is appropriate, and choose the spatial boundary accordingly;
- recognise that individual harvest decisions are made at stand level while at landscape, regional or national levels may be more appropriate in order to consider the impacts of the forest economy, as management responds to market forces;
- consider whether a retrospective or prospective approach is relevant, and choose the temporal boundary accordingly;
- recognise that biomass for bioenergy is typically only one component of a range of products harvested from a managed forest;
- recognise that in addition to forest management (silviculture, harvest), also natural biotic and abiotic forces (e.g. edaphic, climate, disturbances) influence forest carbon stocks, and should be considered whenever possible;
- commence accounting at the time that management changes in response to bioenergy demand, while acknowledging that the chosen perspective, i.e. retrospective or prospective, might impact on this choice;
- recognise that the earth climate system is altered not only by CO_2, but also by changes in the atmospheric concentration of other gases and aerosols, in solar radiation and in land surface albedo, so the effects of all climate forcers influenced by forest cover and forest management should ideally be included;
- recognise that taking both a short- (e.g. less than one rotation) and long-term (e.g. several forest rotations) view may be relevant and probably result in different conclusions; and,
- recognise that a comprehensive analysis of climate impacts of bioenergy is complex and likely be subject to significant uncertainties and sensitivities.

The following research needs have been identified[2]:

- studies clarifying how the energy sector, forest industry and forest management planning respond to changing forest product markets, including bioenergy markets;
- good empirical data on forest product supply and demand and land use, at scales of resolution that enable comprehensive analyses of alternative scenarios;
- development of stronger links between the forest/bioenergy systems modelling and the earth systems/climate science/integrated assessment modelling efforts; and,
- multi-disciplinary research into the interpretation and translation of insights from scenario modelling into policy guidance for management of land use and energy systems.

Conclusions

Quantifying the climate effects of forest-based bioenergy is a complex endeavour and is fraught with challenges. Methodological choices influence the results and the related conclusions dramatically. These choices depend on the goal and scope of the study, and are related to the definition of spatial and temporal system boundaries and climate metrics. A comprehensive understanding of the climate effects of bioenergy systems requires a combination of biophysical, climate and socio-economic models, including effects on parallel industries (e.g. wood products, agriculture and energy), in order to robustly inform policy development.

The timing of emissions and sequestration is important when assessing the effectiveness of bioenergy in climate change mitigation, in particular concerning ambitious stabilization targets (e.g. maximum 2°C temperature increase) requiring rapid and deep cuts in GHG emissions. When planning policies, it is very important to recognise that short- and long-term climate impacts of bioenergy might be very different. A shift to a sustainable bioenergy production system resulting in significant climate benefits in the long-term might also result in less beneficial or even harmful short-term impacts. This can be considered as an investment, acknowledging that the related short-term climate impacts should be reduced by other means, particularly if aiming to achieve ambitious climate targets in the short term.

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[2] These research needs were identified at a workshop on Forests, bioenergy and climate change mitigation held May 19-20, 2014 in Copenhagen, organized by the Joint Research Centre of the European Commission (JRC), the European Environment Agency (EEA), the International Energy Agency (IEA) Bioenergy Tasks 38, 40 and 43 and the International Institute for Sustainability Analysis and Strategy (IINAS). Further details of the workshop are available at http://www.ieabioenergy-task38.org/html/body_copenhagen_2014.html

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International Energy Agency

The International Energy Agency (IEA) is an autonomous organisation which works to ensure reliable, affordable and clean energy for its 29 Member Countries and beyond. Founded in response to the 1973-74 oil crisis, the IEA's initial role was to help countries co-ordinate a collective response to major disruptions in oil supply through the release of emergency oil stocks to the markets. While this continues to be a key aspect of its work, the IEA has evolved and expanded. It is at the heart of global dialogue on energy, providing authoritative and unbiased research, statistics, analysis and recommendations. Today, the IEA's four main areas of focus are:

- Energy security: Promoting diversity, efficiency and flexibility within all energy sectors;
- Economic development: Ensuring the stable supply of energy to IEA Member Countries and promoting free markets to foster economic growth and eliminate energy poverty;
- Environmental awareness: Enhancing international knowledge of options for tackling climate change; and
- Engagement worldwide: Working closely with non-Member Countries, especially major producers and consumers, to find solutions to shared energy and environmental concerns.

Objectives

- To maintain and improve systems for coping with oil supply disruptions.
- To promote rational energy policies in a global context through co-operative relations with non-Member Countries, industry and international organisations.
- To operate a permanent information system on the international oil market.
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use.
- To promote international collaboration on energy technology.
- To assist in the integration of environmental and energy policies.

Organisation

The IEA is an autonomous agency based in Paris. The main decision-making body is the Governing Board, composed of energy ministers from each Member Country or their senior representatives. A Secretariat, with a staff of energy experts recruited on a competitive basis primarily from OECD Member Countries, supports the work of the Governing Board and subordinate bodies. The Secretariat is headed by an Executive Director appointed by the Governing Board. The Secretariat collects and analyses energy data, organises high-level workshops with world experts on new topics and themes, assesses Member and non-Member Countries' domestic energy policies and programmes, makes global energy projections based on differing scenarios, and prepares studies and concrete policy recommendations for governments on key energy topics.

Members

Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the USA. The European Commission also participates in the work of the IEA.

Introducing IEA Bioenergy

Welcome to this Annual Report for 2014 from IEA Bioenergy.

IEA Bioenergy is the short name for the international bioenergy collaboration under the auspices of the International Energy Agency – IEA. A brief description of the IEA is given on the preceding page.

Bioenergy is energy derived from biomass. Biomass is defined as material which is directly or indirectly produced by photosynthesis and which is utilised as a feedstock in the manufacture of fuels and substitutes for petrochemical and other energy intensive products. Organic waste from forestry and agriculture, and municipal solid waste are also included in the collaborative research, as well as broader 'cross-cutting studies' on techno-economic aspects, environmental and economic sustainability, systems analysis, bioenergy trade, fuel standards, greenhouse gas balances, barriers to deployment, and management decision support systems.

The IEA Implementing Agreement on Bioenergy, which is the 'umbrella agreement' under which the collaboration takes place, was originally signed in 1978 as IEA Forestry Energy. A handful of countries took part in the collaboration from the beginning. In 1986 it broadened its scope to become IEA Bioenergy and to include non-forestry bioenergy in the scope of the work. The number of participating countries has increased during the years as a result of the steadily increasing interest in bioenergy worldwide. By the end of 2014, 23 parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Norway, South Africa, Sweden, Switzerland, the United Kingdom, the USA, and the European Commission.

IEA Bioenergy is now 37 years old and is a well-established collaborative agreement. All OECD countries with significant national bioenergy programmes are now participating in IEA Bioenergy, with very few exceptions. The IEA Governing Board has decided that the Implementing Agreements may be open to non-Member Countries, i.e., for countries that are not Members of the OECD. For IEA Bioenergy, this has resulted in a number of enquiries from potential participants, and as a consequence new Members are expected. Three non-Member Countries currently participate in IEA Bioenergy – Brazil, Croatia, and South Africa.

The work within IEA Bioenergy is structured in a number of Tasks, which have well defined objectives, budgets, and time frames. The collaboration which earlier was focused on Research, Development and Demonstration is now increasingly also emphasising Deployment on a large-scale and worldwide. There were 11 ongoing Tasks during 2014:

- Task 32: Biomass Combustion and Co-firing
- Task 33: Thermal gasification of Biomass
- Task 34: Pyrolysis of Biomass
- Task 36: Integrating Energy recovery into Solid Waste Management
- Task 37: Energy from Biogas
- Task 38: Climate Change Effects of Biomass and Bioenergy Systems
- Task 39: Commercialising of Conventional and Advanced Liquid Biofuels from Biomass
- Task 40: Sustainable International Bioenergy Trade – Securing Supply and Demand
- Task 41, Project 4: Biomethane in Heavy Duty Engines
- Task 42: Biorefining – Sustainable Processing of Biomass into a Spectrum of Marketable Bio-based Products and Bioenergy
- Task 43: Biomass Feedstocks for Energy Markets

Members of IEA Bioenergy are invited to participate in all of the Tasks, but each Member is free to limit its participation to those Tasks which have a programme of special interest. The Task participation during 2014 is shown in Appendix 1.

A progress report for IEA Bioenergy for the year 2014 is given in Sections 1 and 2 of this Annual Report.

ExCo74 study tour group on visit to Port of Ghent and Bio Base Europe Pilot Plant, Belgium.

Progress Reports

1. THE EXECUTIVE COMMITTEE

Introduction and Meetings

The Executive Committee acts as the 'board of directors' of IEA Bioenergy. The committee plans for the future, appoints persons to do the work, approves the budget, and, through its Members, raises the money to fund the programmes and administer the Agreement. The Executive Committee (ExCo) also scrutinises and approves the programmes of work, progress reports, and accounts from the various Tasks within IEA Bioenergy. Other functions of the ExCo include publication of an Annual Report, production of newsletters and maintenance of the IEA Bioenergy website. In addition the ExCo produces technical and policy-support documents, and organises workshops and study tours for the Member Country participants.

The 73rd ExCo meeting took place in Copenhagen, Denmark on 21-23 May with 36 participants. The 74th ExCo meeting was held in Brussels, Belgium on 21-23 October and there were 36 participants. Anselm Eisentraut represented IEA Headquarters at both ExCo73 and ExCo74.

Paul Grabowski of the USA, who chaired the ExCo73 meeting, resigned as Member for the USA and from the post of Chair during the summer. He was replaced by Kees Kwant of The Netherlands who chaired the ExCo74 meeting. During ExCo74 in October Kees Kwant was elected as Chair and Sandra Hermle of Switzerland was elected as Vice-Chair for the balance of 2014 and for 2015.

Secretariat

The ExCo Secretariat is currently based in Dublin, Ireland under the Secretary, Pearse Buckley. The fund administration for the ExCo Secretariat Fund and Task funds is consolidated with the Secretariat, along with production of ExCo publications and newsletters, and maintenance of the website.

The contact details for the Executive Committee can be found in Appendix 7 and for the Secretariat on the back cover of this report. The work of the ExCo, with some of the achievements and issues during 2014, is described below.

Implementing Agreement – Renewal

The current term of the Implementing Agreement ends on the 28th February 2015. A request for an extension to the Agreement, which included the new *Strategic Plan 2015-2020* (see Strategic Plan below), the *End of Term Report 2010-2015* and the *IEA Bioenergy Self-Assessment to CERT Criteria*, was submitted to the Renewable Energy Working Party (REWP) in June 2014. The REWP considered the request at their September 2014 meeting at which the IEA Bioenergy Acting-chair Kees Kwant made a presentation on behalf of the Agreement. The request for an extension was approved by the REWP and will go before the Committee on Energy Research and Technology (CERT) in February 2015 for final approval.

Contracting Parties/New Participants

A complete list of the Contracting Parties to IEA Bioenergy is included in Appendix 3.

Correspondence is continuing with potential Member Countries including China, India, Malta, Mexico, Poland, Spain and Thailand. Estonia, which became a member of IEA in 2014, accepted an invitation to observe ExCo74 in Brussels and a dialogue regarding possible membership has commenced.

Supervision of Ongoing Tasks, Review and Evaluation

The progress of the work in the Tasks is reported to the Executive Committee twice per year at the ExCo meetings. The ExCo has continued its policy to invite Task Leaders to each ExCo meeting so that they can make presentations on the progress in their Task and programme of work personally. This has improved the communication between the Tasks and the Executive Committee and has also increased the engagement of the ExCo with the Task programmes.

The work within IEA Bioenergy is regularly evaluated by the IEA Committee for Energy Research and Technology (CERT) via its Renewable Energy Working Party (REWP) and is reported to the IEA Governing Board.

Approval of Task and Secretariat Budgets

The budgets for 2014 approved by the Executive Committee for the ExCo Secretariat Fund and for the Tasks are shown in Appendix 2. Total funds invoiced in 2014 were US$1,935,520; comprising US$261,100 of ExCo funds and US$1,674,420 of Task funds. Appendix 2 also shows the financial contributions made by each Member Country and the contributions to each Task. Very substantial 'in-kind' contributions are also a feature of the IEA Bioenergy collaboration but these are not shown because they are more difficult to recognise in financial terms.

Fund Administration

The International Energy Agency, Bioenergy Trust Account, at the Bank of Ireland Global Markets in Dublin is working well. The Trust Account consists of a Call Deposit account and a Fixed Deposit account both of which bear interest. The Call Deposit account is accessed electronically while the Fixed Deposit account is accessed through the Bank's dealers. Both accounts are denominated in US dollars. The currency for the whole of IEA Bioenergy is US dollars. Details for making payments are:

Arrange an International Telegraphic Transfer/Swift Money Transfer **in US$ only** to:

Beneficiary Bank:	Bank of Ireland Global Markets
Beneficiary Bank Address:	2 Burlington Plaza, Burlington Road, Dublin 4, Ireland
IBAN Number:	IE26BOFI90139471664020
Swift/BIC Address:	BOFIIE2D
Beneficiary:	ODB Technologies Ltd for and on behalf of IEA Bioenergy Trust Account
Beneficiary Account Number:	71664020
Quoting:	Invoice No. xxx

The main issues faced in fund administration are slow payments from some Member Countries and fluctuations in exchange rates. As of 31 December 2014, there was US$174,920 of Member Country contributions outstanding.

At ExCo72, unanimous approval was given to the appointment of KPMG, Dublin as independent auditor for the ExCo Secretariat Fund until 31 December 2015. The audited accounts for the ExCo Secretariat Fund for 2013 were approved at ExCo73.

The Tasks also produce audited accounts. These are prepared according to guidelines specified by the ExCo. The accounts for the Tasks for 2013 were approved at ExCo73.

The audited accounts for the ExCo Secretariat Fund for the period ended 31 December 2014 have been prepared and these will be presented for approval at ExCo75 in Dublin.

Task Administration and Development

Task Participation

In 2014 there were 107 participations in 10 Tasks. Please see Appendix 1 for a summary of Task participation. Norway has joined Task 38 for 2014 and 2015. For 2015, Australia has joined Task 37 and Norway has joined Task 34.

There was one joint project with the Advanced Motor Fuels Implementing Agreement carried out under Task 41 (see page 79).

Strategic Planning and Strategic Initiatives

Strategic Plan

The draft of the fifth Strategic Plan 2015-2020 was further developed by the working group in the 1st quarter of 2014, following feedback from the Members. At ExCo73 in Copenhagen in May, the ExCo carried out a final review of the draft and, subject to minor amendments, unanimously approved it as the Agreement's strategic plan for the period 1st March 2015 to 28th February 2020. Compared to the preceding IEA Bioenergy strategic plan, this plan will place greater emphasis on optimising the economic, environmental and social value of sustainable bioenergy, including some focus on biorefinery value chains. It is expected that the implementation of the Strategic Plan 2015-2020 will

- promote the optimisation of the economic, environmental and social value of bioenergy through
  - research and development collaboration
  - identification of best practices in bioenergy policy
  - pro-active communication with the main stakeholders
- increase participation in our Agreement, particularly by leading players in IEA non-member countries
- facilitate accelerated deployment of bioenergy globally.

Technical Coordinator

Dr Arthur Wellinger has continued in the role of Technical Coordinator. During 2014, his activities included supporting increased collaboration between the Tasks, maintaining links with IEA Headquarters, engaging with other international organisations (e.g. GBEP), and organising and publishing (in conjunction with the Secretary) the ExCo workshops. The work with GBEP has been particularly active and the Technical Coordinator has supported the engagement of IEA Bioenergy Tasks 43 and 40 in a collaboration with GBEP in an

activity group on bioenergy and water. Successful workshops were organised at ExCo73 in Copenhagen and ExCo74 in Brussels and the *ExCo71 – Waste to Energy – Summary and Conclusions* has been published.

Communication Strategy

The Executive Committee supported the continuation of the working group on the Communication Strategy. At ExCo74 a number of actions under the Communication Strategy were discussed. It was agreed that four electronic newsletters would be issued each year in addition to the two that follow ExCo meetings. LinkedIn would be investigated to determine its utility in terms of getting the IEA Bioenergy message out to stakeholders. In the new triennium (2016-2018) Task Leaders would define the target groups for the outputs from their Tasks and proactively work to ensure effective delivery of the outputs.

Strategic Fund/Strategic Outputs

At ExCo53 it was agreed that from 2005, 10% of Task budgets would be reserved for ExCo approved work. The idea was that these 'Strategic Funds' would be used to increase the policy-relevant outputs of IEA Bioenergy.

There has been good progress with strategic initiatives. The summary and conclusions from the ExCo71 workshop 'Waste to Energy' has been formally published and can be download at http://www.ieabioenergy.com/iea-publications/workshops/, as can the publications from other ExCo workshops.

'Mobilising Sustainable Bioenergy Supply Chains': The Strategic Project *Mobilising Sustainable Bioenergy Supply Chains* has the objective to apply an integrative framework for analysis that will inform the debate, improve governance, and contribute to mobilisation of sustainable supply chains globally. Five separate value chains are being examined:

- Boreal and temperate forests
- Regional biogas production from organic residues
- Agricultural residues for bioenergy and biorefineries
- Integration of lignocellulosic crops into agricultural landscapes
- Cultivating pastures and grasslands: the sugar cane ethanol case.

The project, which is led by Task 43 and involves experts from Tasks 38, 39, 40 and 42, is on schedule and the final report will be published towards the end of 2015. In addition, there will be a considerable body of information on the Task 43 website, including supporting documents and summary reports.

A Scientific Workshop with JRC/EEA on Carbon Debt: This workshop brought together experts from IEA Bioenergy Tasks 38, 40 and 43, the European Commission Joint Research Centre (JRC), the European Environment Agency (EEA) and the International Institute for Sustainable Analysis and Strategy (IINAS). The aim of the workshop was to identify where consensus could be achieved, what the diverging views were and why. Research needs were identified including case studies and model interactions to ensure a scientific base for decision-making. The key messages of the workshop will be published in 2015.

Algae Review: Following a detailed discussion of the topic, the ExCo approved a strategic project led by Task 39 to undertake a review of algae for bioenergy. The study will use the Task 39 update report of 2010 as a point of reference. The techno-economic assessment will be reviewed, hydro-treating to green diesel will be incorporated, the programme will be extended to the state-of-the-art on photobioreactors, and heterotrophic production as well as macro-algae (seaweed) will be included. The project will look at the life cycle impacts, include both thermochemical processing and anaerobic digestion and also incorporate value added co-products. Draft conclusions will be available by ExCo75 in Dublin for consideration by the Executive Committee.

Transatlantic Wood Energy Workshop: This strategic workshop, held in Savannah, Georgia on the 24th and 25th October 2013, built on the success of the Quebec workshop on sustainability and explored the potential application of sustainability criteria being developed by European governments and industry. It was organised by Tasks 40 and 43 in association with the Pinchot Institute for Conservation. The workshop was a very successful engagement of key stakeholders. The report *The Transatlantic Trade in Wood for Energy* is available at http://www.ieabioenergy.com/publications/savannah-sustainability-workshop/.

IEA Bioenergy Tasks' Activities 2010-2012

This Report on IEA Bioenergy Tasks' Activities 2010-2012 provides an overview of the work of the 11 Tasks that were active during the 2010-2012 triennium. For each Task the background and objectives are presented, followed by details of its activities and outputs – http://www.ieabioenergy.com/publications/iea-bioenergy-tasks-activities-2010-2012-report/.

Database for IEA Bioenergy

The goal of this database is to present IEA Bioenergy data in a common format, with a focus on the technology Tasks. The principal benefit would be to show bioenergy in an integrated way – having all plants in one scheme, with a link to the website. The development work is progressing and should be completed in 2015.

ExCo Workshops

Two workshops were held in 2014 and the topics were 'Infrastructure compatible transport fuels' (ExCo73) and 'Bioenergy: land use and mitigating iLUC' (ExCo74). Both workshops involved outside experts who brought important insights to the ExCo.

The ExCo73 workshop was a first, joint workshop held with the Advanced Motor Fuels (AMF) Implementing Agreement – see below under the heading Advanced Motor Fuels Implementing Agreement.

The workshop on *'Bioenergy: land use and mitigating iLUC'* was prepared in close collaboration with DG Energy of the European Commission. More than 100 participants, which included representatives from various European government ministries and NGO's, attended presentations by leading experts on this important topic. Eleven speakers and a discussion panel from nine different countries, including Europe, North America and South America, made high quality contributions which fully engaged the audience. The central conclusion of the workshop was that iLUC could be prevented when food, feed and fiber production are married to good agricultural practice. The workshop presentations are available at http://www.ieabioenergy.com/publications/ws19-bioenergy-land-use-mitigating-iluc/.

Summary reports for both workshops are being drafted for publication in 2015.

Seminars, Workshops, and Conference Sessions

A large number of seminars, workshops, and conference sessions are arranged every year by individual Tasks within IEA Bioenergy. This is a very effective way to exchange information between the participants and to transfer information to stakeholders. These meetings are described in the progress reports from the Tasks later in this Annual report. The papers presented at some of these meetings are listed in Appendix 4. Examples of this outreach are:

- Task 32 organised an expert workshop on high temperature corrosion in biomass combustion plants at the World Bioenergy Conference, Jönköping, June, 2014
- Task 34 members held a meeting in conjunction with the Pyro2014 conference, the 20th International Symposium on Analytical and Applied Pyrolysis, held in Birmingham, UK, in May, 2014
- A Task 36 workshop was held in association with the German BREF Working group on Efficiency of energy from waste in Karlsruhe, German in March 2014
- Task 37 held a meeting in April 2014 hosted by Itaipu Binacional in Foz do Iguaçu, Brazil, including a workshop to launch the new international Biogas Task 37 mirror group for Latin America and the Caribbean, CIBiogás

- Task 38 organised a Scientific Workshop on Carbon Debt jointly with Tasks 40 and 43 and the European Commission Joint Research Centre (JRC), the European Environment Agency (EEA) and the International Institute for Sustainable Analysis and Strategy (IINAS) in Copenhagen in May, 2014.
- Task 39 held a meeting in conjunction with the "Fuels of the Future" conference which was held in Berlin, Germany in January 2014
- Task 43 organised a workshop together with JRC, the Scientific Engineering Centre "Biomass" from Ukraine, and the Bioenergy Association of Ukraine on the use of agricultural residues for bioenergy in Kiev, Ukraine in Sept 2014

Collaboration with International Organisations and Implementing Agreements

Advanced Motor Fuels Implementing Agreement

Collaboration with the Advanced Motor Fuels (AMF) Implementing Agreement has continued with very positive benefits for both Agreements. Task 41, Project 4 'Enhanced Emission Performance and Fuel Efficiency for HD Methane engines' is a joint project between IEA Bioenergy and AMF, which was completed in 2014 with two key deliverables:

- *Enhanced emission performance and fuel efficiency for HD methane engines 2014 – Final report* available at http://www.ieabioenergy.com/publications/enhanced-emission-performance-fuel-efficiency-hd-methane-engines-2014-final-report/
- *Enhanced emission performance and fuel efficiency for HD methane engines 2014 – Summary brochure* available at http://www.ieabioenergy.com/publications/enhanced-emission-performance-fuel-efficiency-hd-methane-engines-2014-summary-brochure/.

In conjunction with coincident Executive Committee meetings of both Implementing Agreements in Copenhagen in May, a joint workshop was held with the AMF on the topic of 'Infrastructure compatible transport fuels'. The workshop was very successful and well attended by IEA Bioenergy ExCo Members and Task Leaders, AMF ExCo Members and Observers from Denmark. The workshop presentations are available at http://www.ieabioenergy.com/publications/ws18-infrastructure-compatible-transport-fuels/.

GBEP

Some significant steps have been taken in furthering the relationship between IEA Bioenergy and the Global Bioenergy Partnership (GBEP). As mentioned earlier an important engagement involving Task 43 and Task 40 in an activity group on bioenergy and water has been initiated. This was supported through the offices of the IEA Secretariat who facilitated the engagement between IEA Bioenergy and GBEP. The Technical Coordinator has held discussions with GBEP on other areas where IEA Bioenergy may have a deeper engagement.

FAO

The collaboration with FAO under the MoU signed in 2000 has continued. Olivier Dubois, who has been identified as the primary contact at FAO for IEA Bioenergy, submitted a paper '*Summary of FAO work on sustainable bioenergy, 11/09/2014'* to the ExCo74 meeting in Brussels. The paper included details of FAO activity including:

- The web-based UN-Energy Decision Support Tool for Sustainable Bioenergy (DST), developed by FAO and UNEP – www.bioenergydecisiontool.org/
- The Bioenergy and Food Security Criteria and Indicators Project (BEFSCI) on good practices available at www.fao.org/bioenergy/foodsecurity/befsci
- A 2013 study on bio-slurry as co-product of biogas – available at http://www.fao.org/docrep/018/i3441e/i3441e.pdf.

The paper was welcomed by the ExCo who expressed support for the development of the synergies between the two organisations.

IRENA

Following discussions at ExCo74 the Chair held a meeting with IRENA to explore possible areas of collaboration. Some potential areas included production of innovative biofuels, resource assessment, trade and iLUC, and financing biomass projects. The Chair will present his findings to ExCo75 for consideration of the next steps.

Promotion and Communication

The effective communication of IEA Bioenergy activities and information to stakeholders, in particular to decision makers, is a key priority of ExCo, which is re-emphasised in the new Strategic Plan 2015-2020. The wide range of promotional material available through the Secretariat includes Annual reports, technical brochures, copies of IEA Bioenergy news, the new Strategic Plan, strategic papers, and workshop proceedings. The IEA Bioenergy website is central to this publishing activity.

The 2013 Annual report with the special colour section on 'Waste to Energy', was very well received. Only a few copies from the original print run of 600 remain, with substantially increased distribution in electronic format.

The newsletter 'IEA Bioenergy News', which is distributed in June and December each year following the ExCo meetings, continues to be widely circulated. Two issues were published in 2014. As a special theme the first issue featured bioenergy in Denmark and the second issue featured a brief report on the workshop on *Bioenergy: land use and mitigating iLUC*, which was held in conjunction with the ExCo74 meeting in Brussels. A free subscription is

offered to all interested and there is a wide distribution outside of the normal IEA Bioenergy network. The newsletter is also produced in electronic format and is available from the IEA Bioenergy website. A single page electronic newsletter covering recent ExCo and Tasks' activities was produced and distributed at the end of September. This was the first of this new initiative proposed by the Communications Working Group, which will be a feature of future dissemination from IEA Bioenergy with an anticipated regularity of four times per year.

Two contributions under the banner of 'IEA Bioenergy Update' were provided to the journal Biomass and Bioenergy in 2014 bringing the total to 57. This initiative provides excellent access to bioenergy researchers as the journal finds a place in major libraries worldwide.

Interaction with IEA Headquarters

There is continuing contact between the IEA Bioenergy Secretariat, and IEA Headquarters in Paris and active participation by ExCo representatives in relevant meetings. The Chairman, Technical Coordinator, Secretary, and key Task Leaders have worked closely with Headquarters staff at both administrative and technical levels. In 2014 the Technical Coordinator participated in a webinar organised by the Industry Strategy Group and attended a meeting of the Transport Contact Group in Paris.

Kees Kwant attended the REWP meeting in Golden, Colorado in September. He made a presentation to the REWP in support of the IEA Bioenergy request for extension to the term of the Agreement. He also supported the IEA Headquarters *Bioenergy How2Guide* initiative, attending meetings in Maputo, Mozambique and Campinas, Brazil. With the support of the ExCo he has managed the input from the IEA Bioenergy Tasks to the How2Guide. These guides build on the International Energy Agency's global energy technology roadmap series and seek to respond to the growing number of requests for assistance from emerging and developing economies with the development of low-carbon energy technology roadmaps that are tailored to national frameworks, resources and capacities

Anselm Eisentraut attended both ExCo73 and ExCo74 on behalf of IEA Headquarters. This participation by Headquarters is appreciated by the Members of the ExCo and helps to strengthen linkages between the Implementing Agreement and relevant Headquarters initiatives.

Status reports were prepared by the Secretary and forwarded to the Desk Officer and the REWP following ExCo73 and ExCo74. Information was also sent to Nils-Olof Nylund, Vice Chairman of the End Use Working Party (EUWP) for the Transport sector. This forms part of the exchange of information between Implementing Agreements and the Working Parties. Regular contributions are provided to the IEA OPEN Energy Technology Bulletin. This provides a very useful platform for distributing the IEA Bioenergy newsletter and publications to stake holders. The Bulletin is also one of the most used referral mechanisms for introduction to the IEA Bioenergy website.

IEA Bioenergy Website

The IEA Bioenergy website (www.ieabioenergy.com) has had incremental development in 2014. The content has been updated as required during the year.

From the website statistics for the year 2014 the key data were as follows:

- Total number of users: 19,500
- Total number of sessions: 28,000
- Total number of page views: 74,000

IEA Bioenergy Conference 2015

Work on the conference, which will take place on the 27-28 October 2015 in the Ramada Hotel Berlin-Alexanderplatz, is progressing well. The structure of the conference has been developed by the Scientific Committee and the website (http://ieabioenergy2015.org/) is active.

2. PROGRESS IN 2014 IN THE TASKS

TASK 32: Biomass Combustion and Co-firing

Overview of the Task

The objective of the Task is to stimulate expansion of biomass combustion and co-firing for the production of heat and power on a wider scale. The widespread interest in the work of the Task illustrates the relevance of biomass combustion and co-firing in society. Combustion applications vary from domestic woodstoves to industrial combustion technologies, dedicated power generation and co-firing with conventional fossil fuels.

Generally speaking, biomass combustion technologies are fully mature with high commercial availability and a multitude of options for integration with existing infrastructure on both large and small-scale levels. Nevertheless, there are still a number of challenges for further market introduction, the importance of which varies over time. Priority issues tackled by the Task through different activities in this triennium are:

- Advanced fuel characterisation methods
- Torrefaction of biomass
- The use of CFD tools for optimisation of biomass combustion technologies
- Better designs of woodstoves
- Aerosol emissions from residential solid fuel appliances
- Addressing combustion related challenges in practise
- Increasing co-firing percentages
- 100% conversion projects from pulverised coal to biomass
- Database on biomass co-firing experiences

The specific actions for the Task involve collecting, sharing, and analysing the policy aspects of results of international/national R&D programmes that relate to these priorities. The results of these actions are disseminated in workshops, reports, handbooks, databases etc. In addition, a number of specifically designed, strategic actions are carried out by the Task to catalyse this process.

While most of the above actions are of a technical character, Task 32 also addresses non-technical issues on fuel logistics and contracting, environmental constraints and legislation, public acceptance and financial incentives. An overview of relevant policies is included in the Handbook of Biomass Combustion and Co-firing. In addition, the Task produced a number of reports on harnessing the co-firing potential in both existing and new coal-fired power plants.

Participating countries: Austria, Belgium, Denmark, Germany, Ireland, Japan, the Netherlands, Norway, South Africa, Sweden, Switzerland, and the United Kingdom.

Task Leader: Ir Jaap Koppejan, Procede BV, the Netherlands

Sub-Task Leader for Co-firing: Ing. Robert van Kessel, KEMA, the Netherlands

Sub-Task Leader for Small Scale Combustion: Ing. Eric Smit, Interfocos, the Netherlands

Operating Agent: Ir Kees Kwant, NL Enterprise Agency, the Netherlands

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 32, please refer to Appendices 2, 4, 5 and 6; the Task website www.ieabioenergytask32.com and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

In 2014, the Task organised three internal meetings and three workshops. The internal meetings were used to monitor progress in different Task activities, reflect on Task-initiated workshops, and share recent developments on application of biomass combustion in Member Countries.

Workshops are a proven concept to gather and disseminate information in a structured and effective manner. Invited speakers present the latest insights on one aspect of biomass combustion and/or co-firing, and thereby provide expert information for the participants. These workshops are usually organised in conjunction with high profile bioenergy conferences to attract as wide an audience as possible. The results of the workshops are reported and published on the Task website, and key results are fed back to both the Task participants and the ExCo for evaluation and further dissemination.

In January 2014, a joint workshop on 'progress in commercialisation of torrefaction technologies' was organised with Task 40 and the FP7 project SECTOR at the Central European Biomass Conference in Graz, Austria. It was concluded that 3-5 years ago, expectations about the commercialisation rate of torrefaction technologies were possibly unrealistically high. It takes several years to develop a new thermal processing technology from technology concept to full scale production and have a substantial impact on the world market.

In June 2014, Task 32 organised a workshop on high temperature corrosion in biomass combustion plants at the world bioenergy conference, Jönköping, Sweden. The workshop provided an overview of the fundamental mechanisms behind high temperature corrosion, as well as a number of practical ways to mitigate the corrosion to acceptable levels

In November 2014, Task 32 and ESKOM organised a workshop on 'Opportunities for Bioenergy in South Africa' in Johannesburg. The workshop was used to evaluate the perspectives of various bioenergy technologies in the South African context.

All three workshops in 2014 were combined with a Task meeting. Workshop reports can be downloaded from the Task 32 website. Reports from internal task meetings are available to member countries only, using login credentials.

Work Programme

The progress achieved during 2014 in work programme of the triennium 2013-2015 is shown below:

1. Fuel characterisation, pretreatment, and supply

Publication on new fuel characterisation methods, summarizing the result of recent EU, ERANET and national projects (D13).

Task 32 currently compiles an overview publication of the available results on the advances in biomass fuel characterisation techniques for selected biomass fuels. Major contributions to this report come from Sweden, Denmark, Canada and Germany, as well as an ongoing EU R&D project where the conversion behaviour of 15 fuels in 5 different conversion systems is being investigated. The project involves collaboration with T33 and 34 and will be finalised in 2015.

Expert workshop on progress in torrefaction technologies (D9)

In Jan 2014, Task 32 and Task 40 organised this workshop on the developments and opportunities for torrefaction technologies, and the possible impact on long distance biomass trade.

Status report on torrefaction and other pretreatment technologies (D11)

In 2014 a start was made to update the existing assessment report for the prospects of torrefaction technologies, together with several manufacturers. This report is prepared jointly with Task 40, and will be finalised in 2015.

2. Small scale biomass combustion

Small scale biomass combustion is applied in manually or automatic fired boilers and stoves. The key challenges are the reduction of emissions of particularly aerosols, increase of combustion efficiency and reduction of investment and operational costs. The following actions are carried out:

Expert workshop on highly efficient and clean stoves (D16)

This workshop for policy makers and stove manufacturers will be held on the 29 Oct 2015 in parallel with the IEA Bioenergy Conference in Berlin. The workshop will focus on the effects of furnace design on combustion quality and emissions, small scale dust removal systems, and the effectiveness of policy measures to promote clean woodstoves. It will be organised in close corporation with the European STOVE2020 project.

Expert workshop on the use of CFD as a tool to optimise geometry of biomass combustion systems (D2)

CFD based design tools have significantly improved in the last decade and are now commonly applied for larger utility boiler installations. There are however also numerous cases where CFD based design has led to much better combustion quality of smaller scale boilers, avoiding the need of a 'trial and error' approach for boiler design and reducing development expenses. An expert workshop was held in May 2013 for equipment suppliers and researchers to share practical experiences and address the current opportunities and limitations of CFD based boiler design.

Technical publication on standardization in particle emission measurement techniques, summarizing the status of standardisation regarding particle emission measurements as well as necessary recommendations for future actions (D5)

The standards for particle emission measurement from residential combustion are hard to compare across different European countries. Given the growing awareness of the impact of PM on public health, various attempts to establish a common European method to determine PM emissions has been made within CEN during recent years. In 2015 Task 32 will compile the results of various co-normative and pre-normative research projects that support this process.

Policy paper and background technical report on the health impact of combustion aerosols (D14)

In the past 5-10 years, several studies (e.g. the EU BIOHEALTH project) have been initiated that address the health impact of biomass combustion based aerosols, with different results. A short policy relevant summary will be prepared in 2015, based on the results of these studies which will be documented in a separate background technical report. The paper will address recent R&D work done on the formation and health impact of aerosols from different types of biomass combustion devices (with emphasis on domestic woodstoves), as well as the cost effectiveness of both primary measures and secondary measures for emission reduction.

3. Industrial and utility scale biomass combustion and power generation

For the larger industrial combustion installations, economies of scale effects usually make it more interesting to take technical measures in furnace and boiler design as well as flue gas treatment, so that the options increase for using low grade biomass fuels and process residues. There are however significant challenges related to boiler design and operation, for these fuels, most of which are ash-related, i.e. ash deposition, high temperature corrosion and ash utilisation/disposal.

Workshop on approaches to enable combustion of challenging fuels (D6)

A workshop was organised jointly with VGB Powertech in Berlin in November 2013, to address the technical challenges associated with the pre-treatment and combustion of challenging residues and wastes such as Solid Recovered Fuels, waste woods, poultry litter, etc. The workshop provided a platform for scientists, equipment suppliers and plant operators to describe the current state of the art and to identify cost effective approaches to deal with challenging biomass types.

Publication on optimal design of biomass fired district heating networks (D18)

In 2014, Task 32 has published a report that assesses the causes of varying performances of biomass fired district heating networks. The report evaluates key energy losses in typical district heating plants and the influence of design and operation parameters such as dimensions and insulation of the district heating systems, temperature levels, and other major parameters. The two reports address equipment suppliers, policy makers and end users with the challenge to come up with better designs and operational strategies.

TEA and 'best practice' combustion for CHP in comparison to pyrolysis and gasification (D18)

In collaboration with Task 33 and Task 34, a techno economic evaluation will be performed in 2015 on combustion for CHP to compare it to near term alternatives such as flash pyrolysis and gasification. This collaboration will involve development of comparative cost models with the other tasks. Once the models are developed, conclusions can be drawn as to the differences.

4. Biomass co-firing

The co-firing of solid biomass materials in existing coal fired plants is already a reasonably well-established way of producing electricity and heat from biomass, making optimal use of existing assets. In this triennium, the aim is to improve and extend the existing co-operation on co-firing with policy makers and regulators, research and technology providers, equipment suppliers and power producers.

Workshop on high percentages co-firing and increased fuel flexibility (D4)

An expert workshop will consider the progress that has been achieved, particularly in Northern Europe in the implementation of more advanced biomass co-firing technology. The workshop will highlight practical experiences, co-firing strategies and the developments in biomass supply. This workshop will be held in Sept 2015 at Drax Power Station, jointly with VGB Powertech and the IEA Clean Coal Centre (IEA CCC).

Database on biomass co-firing experiences (D20)

The existing web-database on biomass co-firing experiences is kept updated with the latest information available worldwide. In 2014 a start has been made to restructure the database as a collaborative action with other tasks.

Technical report on biomass milling and combustion in pulverised fuel boilers (D17)

For combustion and co-combustion in a pulverised fuel boiler it is necessary to mill the biomass to a suitable size, to convey the milled biomass and to combust the milled biomass in a suspension. In most cases, this is achieved in equipment that was originally designed for coal. There have been major technical advances in this subject area over the past 10 years or so and significant development work is on-going. A technical summary report is currently being prepared on the achievements and technical experience to date. It will also identify the key technical requirements both for the co-firing of biomass in existing plants and the design of biomass co-firing systems in new plants.

Website

The Task website (www.ieabioenergytask32.com) attracts about 5,000 visitors every month and is one of the key tools for information dissemination. Main products that are being downloaded from the website are publications and meeting reports, the database on experience with biomass co-firing in different power plants, and the databases on the composition of biomass and ash from actual combustion plants. The website is updated on a regular basis. In 2014, two electronic newsletters were produced and distributed to provide information on developments related to the work of the Task, and on biomass combustion and co-firing in general. Task participants and ExCo Members can obtain access to a secured section of the website which includes internal reports and work in progress.

Collaboration with Other Tasks/Networking

The Task collaborates directly with industry and through industrial networks such as VGB Powertech. Within the IEA family, interaction is also solicited with other Bioenergy Tasks or other Implementing Agreements such as the IEA Clean Coal Centre. Market relevance is also enhanced by the active involvement of ExCo Members in the selection of Task participants, based on their national programmes. Several power companies are currently directly involved in the task. Effective coordination is achieved through joint events, and the exchange of meeting minutes and reports.

Deliverables

The following milestones were achieved in 2014. Organising and minuting of three Task meetings. Organising and reporting of three workshops on 'Development of torrefaction technologies and impacts on global bioenergy use and international bioenergy trade', 'High Temperature Corrosion in biomass combustion plants' and 'Opportunities for Bioenergy in South Africa'; publication of reports on 'Sensitivity of System Design on Heat Distribution Cost in District Heating' and 'Status Report on District Heating Systems in IEA Countries'; updating of the international overview of initiatives for biomass co-firing; and maintenance of the Task website. The Task also produced progress reports and audited accounts for the ExCo.

TASK 33: Thermal Gasification of Biomass

Overview of the Task

The objectives of Task 33 are to monitor, review and exchange information on biomass gasification research, development, and demonstration; and to promote cooperation among the participating countries and industry to eliminate technological impediments to the advancement of thermal gasification of biomass. The ultimate objective is to promote commercialisation of efficient, economical, and environmentally preferable biomass gasification processes for the production of electricity, heat, and steam, and for the production of synthesis gas for subsequent conversion to chemicals, fertilisers, hydrogen and transportation fuels, and also for co-production of these products.

Participating countries: Austria, Denmark, Finland, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland and USA.

Task Leader: Dr. Kevin Whitty, University of Utah, USA

Operating Agent: Jim Spaeth, US Department of Energy, USA

The Task Leader directs and manages the work program. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 33, please refer to Appendices 2, 4, 5 and 6; the Task website www.ieatask33.org and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Task Meetings and Workshops

The first Task 33 meeting for 2014 was held on May 13-15, 2014 in Ischia, Italy. The Task meeting was held on the first day and workshop "Thermal biomass gasification in small scale" was held on the second day. The third day included a visit to the ENEA Laboratories and the University of Naples Federico II campus.

The second Task 33 meeting was held on November 03-05, 2014 at KIT, Karlsruhe, Germany. The Task meeting was held on Monday, November 3. The workshop "Liquid biofuels" was held on Tuesday, November 4. The visit to the KIT laboratories and bioliq facility was on Wednesday, November 5.

Work Scope, Approach and Industrial Involvement

The scope of work for the current triennium is built upon the progress made in the previous triennia. In the previous years, information exchange, investigation of selected sub-task studies, promotion of coordinated RD&D among participating countries, selected plant visits, and industrial involvement in technical workshops at Task meetings have been very effective. These remain the basic foundations for developing and implementing a program of work that addresses the needs of the participating countries.

Furthermore, the aim is to increase the number of countries participating in Task 33. France, Canada, UK, Spain and Brazil, for example, are very active in thermal biomass gasification and their membership would be profitable for all participants.

The Task monitors the current status of the critical unit operations and unit processes that constitute the biomass gasification (BMG) process, and identifies hurdles to advance further development, operational reliability, and reduction of the capital cost of BMG systems. The Task meetings provide a forum to discuss the technological advances and issues critical to scale-up, system integration, and commercial implementation of BMG processes. Generally, these discussions lead to selection of sub-task studies and/or technical workshops that focus on advancing the state-of-the-art technology and identify the options to resolve barriers to technology commercialisation.

The Task has continued the practice of inviting industrial experts to the Task workshops to present their practical experiences and to discuss the options for development of critical process components to advance state-of-the-art BMG systems. The interaction with industry provides the opportunity for the National Team Leaders (NTLs) to evaluate refinements to existing product lines and/or processes. Academic experts are also invited as and when the need arises to seek information and cooperation in order to address and support basic research needs.

Work Program/Sub-task Studies

The current work program includes the following elements:

- Plan and conduct semi-annual Task meetings including workshops on sub-task studies selected by the NTLs, and address matters related to the Task mission and objectives. Details are:

Meeting	Associated Workshop	Dates and Location
1st Task meeting	WS1 'Thermal gasification of biomass in small scale'	13-15 May 2014 Ischia, Italy
2nd Task meeting	WS2 'Liquid biofuels'	03-05 November 2014 Karlsruhe, Germany

- Survey the current global biomass and waste gasification RD&D programmes, commercial operations and market opportunities for BMG, and identify the technical and non-technical barriers to commercialisation of the technology. Use the survey results to prepare and update Country Reports for information dissemination.
- Conduct joint studies, conferences, and workshops with related Tasks, Annexes, and other international activities to address issues of common interest to advance BMG systems.
- Identify research and technology development needs based on the results from the work described above as a part of the workshop reports.
- Publish results of the work program on the Task website (www.ieatask33.org) for information dissemination. Maintain the website with Task updates.
- Maintain Task 33 database on thermal gasification facilities worldwide.

Observations from WS1: Thermal biomass gasification in small scale

In Italy in the last 3 years, 5-6 new industrial biomass gasification plants were brought online with a combined electrical generating capacity of about 15-20 MWe. Most of these were small scale, with downdraft technology and coupled with a cogeneration system in order to obtain the thermal energy recovery.

The recent activity in small scale gasification was one of the motivations to hold the workshop on thermal gasification of biomass in small scale in Italy.

Table 1: Workshop presentations

Marco Fantacci, General Manager, BIO&WATT Gasification s.r.l. **Energetical conversion of biomass through pyrogasification process: presentation of an industrial solution**
Andrea Duvia, Gammel Duvia Engineering s.r.l. **Industrial experiences and innovative solutions**
Marcel Huber, Syncraft, Austria **The floating-fixed-bed – status of a unique staged gasification concept on its way to commercialization**
Giovanna Ruoppolo, CNR – National Research Council **Fluidized bed gasification and co-gasification of biomass and wastes**
Marco Fantacci, General Manager, BIO&WATT Gasification s.r.l. **Energetical conversion of biomass through pyrogasification process: presentation of an industrial solution**
Andrea Duvia, Gammel Duvia Engineering s.r.l. **Industrial experiences and innovative solutions**
Marcel Huber, Syncraft, Austria **The floating-fixed-bed – status of a unique staged gasification concept on its way to commercialization**
Giovanna Ruoppolo, CNR – National Research Council **Fluidized bed gasification and co-gasification of biomass and wastes**

All of the workshop presentations as well as the workshop report can be found at the Task 33 website (www.ieatask33.org).

Observations from WS 2: Liquid biofuels

The workshop took place in Karlsruhe, where also the Bioliq® plant for the production of liquid biofuels is situated.

The Bioliq® process offers a solution for high quality fuels or fuel components produced from sustainable biomass. One of the challenges that the process addresses is the widely distributed availability of biomass combined with the need for large scale fuel production plants required by economies of scale. The solution is the de-centralized pre-treatment of biomass to obtain an intermediate energy carrier of high energy density (bioliqSyncrude), which can be transported economically over long distances to supply an industrial plant of reasonable size

for synthetic fuel production. Through gasification and chemical synthesis, fuels are produced which can be used as drop-in fuels or as stand-alone products completely compatible with exiting diesel or gasoline type fuels. Although nearly any type of dry biomass can be utilized for this process, the focus feedstocks are by-products and residues of agriculture, forestry or landscaping. (www.bioliq.de)

Table 2: Workshop presentations

Manfred Wörgetter, Bioenergy 2020+, Austria **Introduction IEA Task 39: Commercializing Liquid Biofuels**
Thomas Wurzel, Air Liquide Global E&C, Germany **2nd generation biofuels – the bioliq technology and economic perspectives**
Rikard Gebart, Luleå University of Technology, Sweden **Conversion of forest industry by-products to methanol and DME**
Sven Petersen, Linde Engineering Dresden GmbH, Germany **Carbo-V – Biomass Gasification Technology**
Malin Hedenskog, Göteborg Energi, Sweden **GoBioGas Project – Experiences and Operational Progress**
Ralf Abraham, Norbert Ullrich, UHDE GmbH, Germany **An update on the BioTfueL Project and other activities of TKIS-PT in the area of biomass gasification**
John Bøgild Hansen, Haldor Topsøe, Denmark **Haldor Topsøes biobased sustainable fuel production technologies**
Jörg Sauer, KIT – Institut fuer Katalyseforschung und -technologie (IKFT), Germany **Modified MtG-processes for BtL and Pwer-to-Fuels**
Thomas Bülter, EVONIK Industries AG, Deutschland **Speciality chemicals from syngas fermentation**
Peter Pfeiffer, KIT – Institut für Mikroverfahrenstechnik (IMVT), Germany **Technology for Fischer-Tropsch synthesis of liquid fuel in small scale**

All workshop presentations can be found at the Task 33 website (www.ieatask33.org) and the workshop report will be available soon.

Website and database

The Task website (www.ieatask33.org) is the most important tool for dissemination of information and results from this Task. Descriptions of the gasification process and a description of the Task including the contact data of national experts are given. Within 2 weeks after each Task meeting, all presentations in PDF form (Country Reports, Workshop presentations) can be found on the Task website. The Minutes are posted on the website as soon as all Task members provide their feedback. The summaries of the workshops can be found on the website in a Report form.

A Google-map based interactive database of implementations of gasification plants has been incorporated into the Task website. At the moment, there are over 150 gasification facilities, mostly in member countries, registered in the database. The database is interactive, which means that the technology, type, and status of the gasifiers can be chosen to filter all the gasification facilities registered in the database. The database is updated regularly and provides a good overview on gasifiers throughout the world.

At the moment, a status report on thermal biomass gasification in member countries is being prepared. The report will include the description of the technology, policy in member countries and a list of all biomass gasification facilities, which are active in the Task 33 database.

Deliverables

The Task deliverables include planning and conducting two semi-annual Task meetings focused on the workshops selected by the Task participants, involving academic and industrial experts; the preparation and distribution of workshop reports and newsletter; updating and publishing Country Reports; conducting joint studies, conferences, and workshops with related Tasks, Annexes, and other international bodies to address mutually beneficial issues; and preparation of periodic progress, financial and annual reports as required by the IEA Bioenergy Excecutive Committtee (ExCo).

TASK 34: Pyrolysis of Biomass

Overview of the Task

The objective of the Task is to improve the rate of implementation and success of fast pyrolysis of biomass for fuels and chemicals (where this complements the energetic considerations) by contributing to the resolution of critical technical areas and disseminating relevant information particularly to industry and policy makers. The scope of the Task is to monitor, review, and contribute to the resolution of issues that will permit more successful and more rapid implementation of biomass pyrolysis technology, including identification of

opportunities to provide a substantial contribution to bioenergy. This will be achieved by a programme of work, which addresses the following priority topics: norms and standards; analysis – methods comparison and developments; and country updates and state-of-the-art reviews.

Pyrolysis comprises all steps in a process from reception of biomass in a raw harvested form to delivery of a marketable product as liquid fuel, heat and/or power, chemicals and char by-product. The Task focus is on fast pyrolysis to maximise liquid product. The technology review may focus on the thermal conversion and applications steps, but implementation requires the complete process to be considered. Process components as well as the total process are therefore included in the scope of the Task, which covers optimisation, alternatives, economics, and market assessment.

The work of the Task addresses the concerns and expectations of the following stakeholders: pyrolysis technology developers; bio-oil applications developers; equipment manufacturers; bio-oil users; chemical producers; utilities providers; policy makers; decision makers; investors; planners, and researchers.

Industry is actively encouraged to be involved as Task participants, as contributors to workshops or seminars, as consultants, or as technical reviewers of Task outputs to ensure that the orientation and activities of the Task match or meet their requirements. Participants at recent meetings have included representatives from biomass pyrolysis industry leaders, Ensyn and BTG.

Participating countries: Finland, Germany, Netherlands, Sweden, United Kingdom, and USA

Task Leader: Mr Douglas Elliott, Pacific Northwest National Laboratory, USA

Operating Agent: Mr Jim Spaeth, US Department of Energy, USA

The Task Leader directs and manages the work. A National Team Leader from each country is responsible for coordinating the national participation in the Task. For further details on Task 34, please refer to Appendices 2, 4, 5 and 6; the Task website www.pyne.co.uk and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings

Task 34 members convened in Solihull, UK, on May 15-16, 2014, in conjunction with the Pyro2014 conference, the 20th International Symposium on Analytical and Applied Pyrolysis held in Birmingham, UK, May 19-23.

Agenda of the TASK 34 Meeting

Introductions:

Participating countries were represented by their national team leaders: Douglas Elliott, US; Dietrich Meier, Germany; Bert van de Beld, Netherlands; Tony Bridgwater, UK; and Magnus Marklund, Sweden; with Ville Paasikallio representing Finland. Also in attendance were observers Daniel Nowakowski, Chunfei Wu, José Medrano, Sai Gu, and Irene Watkinson from UK, Paul de Wild from Netherlands, Tim Schulzke from Germany and Akwasi Boateng from US.

Country Reports:

Reports were presented by representatives from US, Netherlands, Finland, UK, Sweden and Germany. Observer presentations were also made from UMSICHT, Germany; University of Leeds, UK; Future Blends, UK; and Cranfield University, UK.

Status of Inter-Task Collaborations:

Efforts with Tasks 32 and 33 were discussed. With Task 38, the LCA produced by US and Finland will be provided for review. The collaboration with Task 39 has developed into an effort to produce an on-line database of pyrolysis systems. A contract was being negotiated. Task 42 has requested input from Task 34 on reviewing their fact sheet on bio-oil production, gasification, and product synthesis.

Norms and Standards:

Developments within the CEN working group were presented and discussed. An update paper on bio-oil norms and standards is in the works with Anja Oasmaa as the lead author.

Round Robin:

The round robin to examine the consistency of bio-oil production within the fast pyrolysis community is underway. The US was to provide the feedstock in three standard forms, clean poplar wood, wheat straw, and a blended feedstock of those two with pine forest residue. Twenty labs have joined the round robin representing all six participating countries.

Bio-oil Applications:

Incorporation of the 'Applications' of bio-oil information recently posted to the Task website was to be part of an updated pyrolysis brochure. Development of a publication plan is ongoing.

Topics for Group Assignment:

- *Website Review* – During group discussion, it was identified that a number of improvements and updates were needed. Input from each participant was solicited.
- *Newsletter* – Writing assignments were made for the next issue of the newsletter.
- *Task Plan for Next Triennium* – New topic areas for the next triennium were discussed.

The meeting attendees also toured Aston University's European Bioenergy Research Institute (EBRI) in Birmingham, UK.

Task 34 members also convened in Finland, on October 28-30, 2014.

On October 28, many of the meeting participants gathered for a technical tour to Joensuu in eastern Finland. The tour consisted of a visit to the Fortum plant, Joensuu Science Park, University of Eastern Finland and the Finnish Forest Research Institute (Metla) all in Joensuu. Fortum provided the task members with a detailed overview of the operation of the integrated fast pyrolysis plant and answered questions before leading the members on a site tour. University of Eastern Finland staff presentations included a laboratory tour in spectral imaging. At the Metla House, UEF staff presentations included discussion of sustainable biomass, discussion of sourcing optimal raw materials, a talk on chemical fingerprinting bio-oil, discussion of pyrolysis research and discussion of wood science research. The visit finished with a tour of the bio-oil analysis laboratories.

The business meeting of the Task convened at VTT in Espoo on October 29.

Introductions:

Participating countries were represented by their national team leaders: Doug Elliott, US; Dietrich Meier, Germany; Anja Oasmaa, Finland; Bert van de Beld, Netherlands; Tony Bridgwater, UK; and Magnus Marklund, Sweden. Also in attendance were observers from participating countries Irene Watkinson and Katie Chong from the UK, Ville Paasikallio from Finland, and Alan Zacher from the US. In addition, Kai Toven an observer from Norway and the Finnish ExCo member, Kai Sipilä, were both present.

Country Reports:

Reports were presented by representatives from the US, Netherlands, Germany, UK, Sweden and Finland. Kai Toven indicated that the growing interest in pyrolysis in Norway would lead to their participation in the Task beginning in 2015.

Status of Inter-Task Collaborations:

The effort with Task 32 involved discussions of bio-oil combustion relative to biomass combustion between the Task 32 Leader with BTG-BTL of the Netherlands. Relative to Task 33, Task 34 will be represented in their upcoming task meeting and discussions of bio-oil gasification should be on the agenda. With Task 38, the LCA produced by the US and Finland was provided for review. A contract has been signed with Bioenergy 2020+, who will develop the web interface of an online demo plant database as an outgrowth of the collaboration with Tsk 39. Demo plant information will be validated by the task for posting. For Task 42, Task 34 arranged a review of their fact sheet on bio-oil production, gasification, and product synthesis.

Round Robin:

The Round Robin to examine the consistency of bio-oil production within the fast pyrolysis community is underway. The US has provided the feedstock in three standard forms; clean poplar wood, wheat straw, and a blended feedstock of those two with pine forest residue. 20 labs have joined the round robin representing all six participating countries. It is anticipated that the bio-oil production runs will be completed by the end of the year. Results of the Round Robin will be distributed to the participants early in 2015 and should be published later in 2015.

Bio-oil Applications:

Development of a publication plan for the information collected on bio-oil applications is underway. The expected effort involves an update of the earlier IEA Bioenergy Biomass Pyrolysis document.

Newsletter:

Writing assignments were made for the next issue of the newsletter.

Norms and Standards:

Developments within the CEN working group were presented and discussed. An update paper on bio-oil norms and standards is in the works with Anja Oasmaa as the lead author. Plans were made for subsequent meetings.

On October 30, the task members participated in the BEST (Sustainable Bioenergy Solutions for Tomorrow) seminar in Helsinki. The morning agenda included presentations given on IEA Bioenergy Task 34, the Joensuu plant by Valmet, on the status of the Empyro plant in the Netherlands by BTG, Green Nordic Fuels, bio-oil combustion by Oilon and CEN standardization by Fortum.

Work Programme and Progress in 2014

The work typically consists of Task meetings, workshops, technical tours, and Task projects, in addition to the 'usual' Task management and ExCo support actions. Among the work efforts were the following:

- The standards development effort in Europe continued forward. A Working Group was organized. Two of the NTLs from Task 34 are active members of the Working Group. Input was provided to the Working Group on bio-oil analytical methods.
- The round robin on bio-oil production was established. Distribution was made of three biomass feedstocks to 20 laboratories in the six participating countries. The product bio-oils were being produced and collected for analysis by the end of the year. The results of the Round Robin will be published in a technical journal.

- A continuing effort is the sharing of updated country reports by each of the participants at each of the Task meetings. These country reports are the basis for the continually updated Country Report portion of the Task website. Using the input collected in 2013 on Applications for bio-oil, planning for a new descriptive brochure on biomass pyrolysis was underway.
- The development of a comparative technoeconomic assessment of fast pyrolysis and hydrothermal liquefaction was completed by two of the Task 34 participants. The LCA based on the process models generated was shared with Task 38 as the basis for inter-task collaboration in the development of life-cycle analysis of fast pyrolysis of biomass.
- A web-based demo plant database developed by Bioenergy 2020+ was initiated with the signing of a contract with the development group.

Newsletter

The Task newsletter continues the tradition of the PyNe newsletter and is an important vehicle for dissemination of relevant information. It is circulated to participants via the Task 34 website in electronic format. Issue 35 was published in July 2014 and Issue 36 was published in January 2015.

Website/Dissemination

The Task 34 website is an important mechanism for information and technology transfer. It is revised and updated under a contract with Aston University. An important development in 2014 was a complete revision and updating of the information under the heading of Applications, which includes all developments on the utilization of bio-oil from fast pyrolysis.

Collaboration with Other Tasks

The proposed work plan for Task 34 included collaborative efforts with five other tasks. These collaborations are at various stages of organization and start-up and are expected to be completed as planned by the end of the triennium.

Deliverables

Deliverables for 2014 were: reporting to the ExCo (Annual Report, progress reports, and audited accounts); continuation and updating of the Task website; two issues of the Task newsletter; organisation and minuting of two Task meetings. Establishment of a Round Robin on bio-oil production.

TASK 36: Integrating Energy Recovery into Solid Waste Management

Overview of the Task

In 2012 the World Bank estimated that there was around 1.3 billion tonnes of waste produced per annum globally and that this would grow to 2.2 billion tonnes/year by 2025. They attributed this rise in waste production to increased urbanisation in developing and emerging economies and the increase in per capita production of waste as a result of this trend. This trend is a considerable challenge for many countries. To meet the challenge there will need to be intensive legislative, managerial and institutional changes, including the introduction of strategic direction aimed at decreasing and controlling waste production; and the development of recycling, reduction and re-use as well as energy technologies to decrease the impact of waste. IEA Bioenergy Task 36 investigates the interface between waste management and energy recovery. Our prime aim is to understand the implications of technical and policy changes in the waste area that impact the integration of energy into solid waste management; and to provide support by disseminating and exchanging information on these developments.

Waste production varies markedly across the work, in terms of composition and quantity. Strategies and solutions that are appropriate in one region may not be right elsewhere. The consequence of this is that countries have different approaches to challenges in waste arisings, reflected in different mixtures of treatment and disposal. Nevertheless there are also common themes. Uppermost in these are concerns relating to the increasing quantities of waste needing to be treated and the impact of landfilling mixed wastes on the environment. In some regions additional pressures arise from decreasing available landfill void space. This is driving policy makers to examine alternatives to landfill, including reduction and recycling of waste, and recovery of value from waste, commonly encompassed in the 'Waste Hierarchy', which is governed by a set of principles dedicated to minimising the impacts of waste and improving resource use. In some regions there are calls for 'zero waste to landfill' and for policy to encourage the circular economy or 'smart waste management'. These moves are most advanced in the European Union and other regions where landfill is expensive or scarce. Elsewhere, notably in North America and Australia, countries continue to rely on landfill, but in these countries there are also increasing pressures to reduce waste production and to recycle or recover where possible, leading to increased interest in recovery of energy from the residual waste. Globally these policy pressures have led to a proliferation of research work on waste management, including policy development, environmental systems analysis, technology development and economic drivers. Whilst this has assisted in the development of more sophisticated waste management systems, in many cases it has also delayed deployment of energy recovery systems (specifically for residual wastes), in particular due to confused policy making, public awareness (and opposition) and uncertainty over environmental performance and technology performance.

Against this background decision makers continue to require guidance and information on waste and resource management systems that are environmentally and economically sustainable. Task 36 provides a unique opportunity to draw together information on how systems, policies and technologies are being applied in different countries to provide guidance for decision makers on key issues. It has already provided a guide to waste management systems in participating countries, which includes an overview of energy recovery options using combustion systems. Over the past year it has provided up to date workshops on key topics influencing energy recovery from waste.

Participating countries: France, Germany, Italy, Norway, Sweden and the United Kingdom.

Task Leader: Dr Pat Howes, Ricardo-AEA, United Kingdom

Operating Agent: Dr Elizabeth McDonnell, Department of Energy and Climate Change, United Kingdom

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 36, please refer to Appendices 2, 4, 5 and 6; the Task website www.ieabioenergyTask36.org and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task meetings and workshops

Over the 2013-14 period the Task has held a series of seminars and workshops in association with Task meetings on topics that are important to energy recovery from waste in each host country. The topics for these workshops were:

- The interface between anaerobic digestion and energy from waste (held in 2013)
- The use of solid recovered fuels derived from waste (held in 2013)
- The management of energy from waste systems to optimise efficiency and recovery (held in 2014)
- Energy from waste – the Next Generation (held in 2014)

In addition two topic reports are being produced on:

- Small–scale energy from waste systems
- Gasification/pyrolysis for waste treatment to produce energy and/or chemicals.

Workshops held over the past 12 months were:

The management of energy from waste systems to optimise efficiency and recovery

This workshop was held in association with the German BREF Working group on Efficiency of energy from waste. Attendees included the IEA Bioenergy Task 36 participants and representatives of the German Umweltbundesamt (EPA), German waste to energy associations and German plant operators. The discussion centred on the potential for efficiency improvements in energy from waste, such as increases in the use of heat, or improvements in the design of the plant. However, in reality although it is possible to achieve higher efficiencies, this may make operation more complicated and increase costs.

The discussion indicated that the conflict between improving efficiency of plants, the cost and complexity of doing so and the implications for gate fees is very important for plant operators. Currently one issue facing German waste to energy operators is over-capacity of plant resulting in competition for waste and decreasing gate fees. Thus, although efficiencies of up to 37% could be reached the cost of doing so may make the plant uncompetitive.

Energy from waste – the Next Generation

This workshop examined the development of technologies that would allow flexible integration of energy into solid waste management and the circular economy; and the very real issue of how we can support and fund the commercialisation of advanced thermal conversion technologies to deliver the changes that enable more efficient and effective use of residual waste as a resource. It concluded that current EfW technologies are likely to continue to dominate the current situation and that there is a role for energy within the circular economy. Advanced thermal systems will have an increasingly important part to play in the future, providing the current advances that are being made can be supported through policy and the technologies can continue to be funded during the commercialisation phase.

Task Meetings

The Task held two meetings in 2014. The first took place on 10-12th March 2014 in Karlsruhe, German. This meeting was held in association with the workshop on efficiency of energy from waste described above. A study tour allowed the Task to visit the Mainz EfW plant.

The second Task meeting took place in Harwell, Oxfordshire, UK on 28th – 30th October 2014. This meeting including the workshop on Energy from waste – the next generation described above. The task also visited the New Earth Solutions waste gasification facility at Avonmouth in Bristol. A meeting note and note on the site visit is available on the Task 36 web site.

Website

The website (www.ieabioenergyTask36.org) is the key tool used for dissemination of information from the Task. It provides access to the latest publications produced by the Task, including the presentations from the two workshops. The website also provides access to past reports, articles, case studies and presentations at workshops associated with Task meetings. In addition, it provides a 'members only' forum, to allow rapid access to the latest drafts of documents and to information on Task meetings. In 2014, there were over 84500 visits to the website, with an average of 232/day. These were fairly evenly spread across the year. The country of origin of 60% of these visits is unknown, but of the remainder the UK, France, China and the USA dominated the use of the site, followed by Germany and the Ukraine. Other countries visiting the site included Russian Federation, the Nordic States, Italy, the Netherlands, Australia, Japan, South Korea and India. The pages most often visited were the publications pages, including all publications from 1998 to the current time.

Deliverables

The deliverables for the Task in 2014 have included presentations for the two Workshops. A further deliverable was the presentation of a paper titled *'An Evaluation Of Arisings And Markets For Waste Derived Fuels In Wales'* at the 5th International Symposium on Energy from Biomass and Waste in Venice in November. The Task also prepared two progress reports and an annual audit report for the Executive Committee. These are listed in Appendix 4.

TASK 37: Energy from Biogas

Overview of the Task

The main objective of the Task 37 work programme is to address the challenges related to the economic and environmental sustainability of biogas production and utilisation. While there are thousands of biogas plants in OECD countries, operation in the vast majority of cases can only be sustained with the help of subsidies to be able to compete with the fossil energy industrial sector. There is a clear need to enhance many of the process steps in the biogas production chain in order to reduce both investment and operating costs and to increase income.

The approach of Task 37 involves the review and exchange of information and promotion of best practices for all steps of the process chain for anaerobic digestion (AD) of biomass residues and energy crops for the production of biogas as a clean renewable fuel for use either directly in combined heat and power generation or after up-grading to biomethane where it replaces natural gas. The Task also addresses utilisation of the residues of the AD process, the digestate, and the quality management methods for conversion to high quality organic

fertiliser. The scope of the work covers biogas production at small and large farm-scale, in waste water treatment plants and treatment of the biodegradable fraction of municipal waste (biowaste), energy crops and algae.

Until recently the environmental performance of biogas production and utilisation had not been assessed in detail. Recent studies have highlighted concerns about emissions of greenhouse gases at various stages of the biogas production chain. In collaboration with a Swedish nationally-funded project, Task 37 started to address emissions and is now directing attention to environmental sustainability of biogas production and utilisation and to defining best practices for emissions reduction. A report on this topic is scheduled for publication in 2015.

Through the work of the Task, communication between RD&D programmes, relevant industrial sectors and governmental bodies is encouraged and stimulated. Continuous education is addressed through dissemination of the Task's publications in workshops, conferences and via the website. Information and data collected by the Task is used increasingly for providing support to all levels of policy making and the drafting of standards in Member Countries.

Participating countries: Austria, Brazil, Denmark, Finland, France, Germany, Ireland, Korea, the Netherlands, Norway, Sweden, Switzerland, United Kingdom, and the European Commission. Australia joins the Task in 2015.

Task Leader: Dr David Baxter, European Commission, JRC Petten, the Netherlands

Operating Agent: Dr Kyriakos Maniatis, European Commission, Brussels, Belgium

The Task Leader directs and manages the work programme. National Team Leaders are responsible for coordinating the national participation in the Task and for coordinating specific topics in the work programme.

For further details on Task 37, please refer to Appendices 2, 4, 5 and 6; the Task website http://www.iea-biogas.net/ and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

Two Task meetings were held in 2014. The first meeting was hosted by Itaipu Binacional on April 2 to 4 in Foz do Iguaçu, Brazil. On April 4, a launch workshop was held for the new international Biogas Task 37 mirror group for Latin America and the Caribbean, CIBiogás. Presentations were made by Task 37 members on a range of topics that attract interest in the region covered by the mirror group. The main aim was to see how a coherent work programme could be developed and integrated in the coming years. CIBiogás has agreed collaboration with FAO and OLADE (Latin America Energy Organisation).

The second meeting took place on October 15th to 17th in Angers, France, and was hosted by ADEME. In place of a technical workshop, extra time was taken to visit three biogas facilities designed to treat different feedstocks and at different scales. These plants included small farm-scale manure treatment using a batch process for heat production, a centralised agricultural residues plant producing heat for local customers and electricity for the grid and a plant treating food processing industry waste and animal slurry to produce biomethane for gas grid injection.

Planning of Future Task Meetings and Workshops

Task meetings in 2015 will be held in Uppsala, Sweden (25-27 March), in conjunction with the Sweden Green Gas conference, and in Berlin, Germany (29 – 30 October) in conjunction with the end of triennium IEA Bioenergy conference.

Work Programme

In 2014 the work programme consisted of the following Topics:

- Continuation of on-going work on preparation of technical brochures
- Collaboration with other Tasks (main activity with Tasks 40)
- Reports to ExCo73 and ExCo74
- Extending the range of published Success Stories and Case Studies
- Consolidating contacts with the growing number of national mirror groups
- Website: updating; maintenance; proceedings, country reports, plant lists, etc.
- Planning of future Task meetings and workshops

Some of the Task members participated in the 22nd European Biomass Conference in Hamburg at which biogas was a key focus. There has been close cooperation with a Swedish national project on measurement of methane emissions from biogas plants and with the European Biogas Association (EBA).

The progress made on Task Topics is summarised below.

New Technical Brochures/Reports

Two new technical brochures were published in 2014. The first on "Pretreatment of Feedstock for Enhanced Biogas Production" was the product of an extended study at University of Natural Resources and Life Sciences (BOKU) in Austria. The report contains assessments of a wide range of existing and novel mechanical, thermal, chemical, biological and combined pretreatment technologies and their methods of use on biogas feedstocks. Advantages and disadvantages of the methods are discussed, also in relation to relative investment and operating costs. Where appropriate, approaches to best practice pretreatments are

defined. Optimum feedstock pretreatment can lead to increased biogas yield and increased rate of biogas production, both having a positive impact on process economics.

The second technical brochure on "A Perspective on the Potential Role of Biogas in Smart Energy Grids", was the product of collaboration between four Task 37 members, Sweden (Energiforsk), Ireland (University Collage Cork), Brazil (Itaipu Binacional) and Germany (DBFZ). The report addresses the challenges arising because of the growth of fluctuating electricity generation from renewable sources, particularly solar and wind. Biogas and biomethane can be stored for long periods of time enabling electricity demand to be met even when there is little output from other renewables. Options for power to gas using over-supply of electricity to produce hydrogen in combination with CO_2 from biogas upgrading to biomethane and demand driven biogas production are assessed. These options give the opportunity for biogas plants to benefit from higher electricity prices at times of high demand while providing the service of electricity grid balancing.

One new IEA Bioenergy report was published jointly in collaboration with Task 40. The report, "Biomethane – status and factors affecting market development and trade", summarised the status of biomethane production from biogas in IEA countries, the development of supply strategies, the challenges facing expansion of trade and expected future perspectives for development of the biomethane sector.

The Task published for the first time a Country Report Summary in January 2015. The summary contained information on the biogas sector in each of the member countries, including energy recovery data, biogas utilisation data, details of support schemes and key research projects.

New Success Story and Case Studies

Three new Case Studies were published in 2014. The first covered operation of a very large scale biogas facility in Maabjerg, Denmark, that is being prepared for integration with a liquid biofuel biorefinery. The second describes the process of converting an existing waste water treatment plant in Denmark to efficient biogas production for CHP and upgrading to biomethane. Lastly, a project to produce liquefied biomethane in central Sweden is described as an example of biogas utilisation in an area remote from the natural gas grid.

One Success Story was published on the experiences of successful operation of a large-scale municipal food waste biogas facility in Helsingborg, Sweden.

National Biogas Mirror Groups

Sweden – Brazil – UK
Country member Brazil initiated a new mirror group in 2014 for biogas in Latin America and the Caribbean, which has at its centre the "International Centre for Renewable Energy – CIBiogas-ER".

In collaboration with the Swedish biogas mirror group, Task 37 has been involved in collaboration with a Swedish-funded project on methane emissions measurement. The project assesses methodologies for making methane emissions measurements on operating biogas plants, carries out biogas plant measurements and assesses options for best practices with regard to emissions management. A workshop was hosted by the Inter Baltic Biogas Arena (IBBA) in September 2014 to discuss methane emissions from biogas plants; both the Swedish project and Task 37 participated. Emission of methane is the topic of a Task 37 report scheduled for publication in 2015.

Website

The website (www.iea-biogas.net) is updated with news, biogas data and publications on a regular basis. The Country Reports as well as the Task publications, proceedings of the workshops and newsletters were made available along with important publications from the participating countries.

Collaboration with Other Tasks

Task 37 collaborated closely with Task 40 on a study on biomethane, status and factors affecting market development and trade, which resulted in an IEA Bioenergy publication in September 2014.

The Task started collaboration with Task 42 on a strategic study concerning biomass mobilisation.

Task 37 collaborates with a Swedish national project on methane emissions measurements from biogas plants. The main role of Task 37 is life cycle assessment input to the project and this will involve collaboration with Task 38 on LCA model assessment and review.

Deliverables

The deliverables for the Task included: publication of technical reports, success stories and case studies, minutes of the Task meetings, progress reports to ExCo73 and ExCo74, Country Reports (including consolidated Country Report summary), one technical workshop in collaboration with national organisations in Brazil and one workshop in which Task 37 provided support to a multinational biogas association in Europe (IBBA), and maintenance of the Task website.

TASK 38: Climate Change Effects of Biomass and Bioenergy Systems

Overview of the Task

The main drivers for bioenergy are mitigation of global climate change, concerns about energy security, and rural development. The reduction of greenhouse gas (GHG) emissions has become an issue of great international importance. Ever increasing evidence of climate change and its impacts, together with developments in emissions trading through international, regional, national, bilateral and multilateral agreements, have greatly augmented interest in reducing GHG emissions and enhancing carbon sequestration. There is a strong debate on the climate change effects of bioenergy systems, and the appropriate role for bioenergy in climate policy.

The primary goal of *IEA Bioenergy Task 38* on *Climate Change Effects of Biomass and Bioenergy Systems* is to promote the sustainable use of biomass and bioenergy through increased understanding of the climate change effects of biomass production and utilisation for energy. We devise and promote standard methodology for quantifying the climate change effects of forest carbon sequestration and bioenergy systems. Our objective is to support decision makers in government and industry, in the selection of climate change mitigation strategies.

Participating countries: Australia, Brazil, Finland, France, Germany, Sweden, Norway, and USA

Task Leader: Annette Cowie, University of New England/New South Wales

Operating Agent: Stephen Schuck, Bioenergy Australia, Australia

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 38, please refer to Appendices 2, 4, 5 and 6; the Task 38 website http://task38.org/ and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

During 2014 Task 38 held two face-to-face meetings of national team leaders, two web meetings, organised one Task 38 workshop, and co-organised one joint workshop.

1. *Web Business Meeting: March 28th*

   a. Six out of the eight participating countries (Australia, Finland, France, Norway, Sweden, USA) were represented in the web meeting.

   b. Key discussion points:

      - Planning for the upcoming Copenhagen workshop;
      - Brief input from NTLs on recent developments in each country;

2. *Joint Task Workshop: Copenhagen 19-20 May*

   a. Experts from Task 38 participated in the workshop jointly organised by Tasks 38, 40, 43, the European Commission's Joint Research Centre, the European Environment Agency and the International Institute for Sustainability Analysis and Strategy: Scientific Workshop on forests, bioenergy and climate change mitigation

   b. Key discussion points:

      - Dialogue between scientists on quantifying climate effects of forest-based bioenergy
      - Identification of key points of convergence and divergence
      - Clarification of basis for alternative perspectives
      - Workshop statement articulating key points of agreement

3. *Business/Expert meeting: Copenhagen: May 21st*

   a. Four out of Eight participating countries (Australia, Finland, Sweden, USA) were represented at the business & expert meeting. Also, experts from Denmark, The Netherlands and New Zealand participated.

   b. Key discussion points:

      - the reference system paper in development
      - Task 38 input to the inter-task project Mobilising Sustainable Bioenergy Supply Chains
      - summary of the IPCC Fifth Assessment Report findings on bioenergy and climate change mitigation
      - discussion of recent controversial scientific papers
      - Brief input from NTLs on recent developments in each country

4. *Web Business Meeting: September 9th*

   a. Six out of the eight participating countries (Australia, Brazil, Finland, Norway, Sweden, USA) were represented at the web meeting.

b. Key discussion points:

- Planning the upcoming Task 38 meeting in Helsinki
- Update on Copenhagen workshop statement situation
- Progress of papers in development.
- Brief input from NTLs on recent developments in each country

5. Business/Expert meeting: Helsinki: December 8th

a. Five out of eight participating countries (Australia, Finland, Germany, Sweden, USA) were represented at the business meeting.

b. Key discussion points:

- Progress of papers in development.
- Discussion of recent literature, with focus on climate effects of forest-based bioenergy
- Updates on significant international policy developments
- Planning for Work programme 2015 and new triennium
- Planning for the next business meeting and final meeting of the triennium
- Updates on Task administration
- Brief input from NTLs on recent developments in each country

Work Programme

In 2014 the Task:

- Organised two Task 38 face to face business meetings, two web business meetings (see above)
- Co-organised one expert working meeting on the theme of quantifying climate effects of forest-based bioenergy (see above)
- Organised a one day workshop with invited Finnish and Swedish forest modelling experts on "Forest-based Bioenergy" after Helsinki business meeting (see below)
- Progressed the preparation of scientific papers:
  - Metrics, associated uncertainties, and discounting:
  - Reference Systems for evaluating climate effects of bioenergy
- Participated in one Inter-Task project ("Mobilising Sustainable Bioenergy Supply Chains")
- Participated at ExCo74 in Brussels

1. Scientific Papers

The following scientific papers are under preparation:

Reference systems for evaluating climate effects of bioenergy
Stemming from the two expert meetings in 2014, this paper will discuss the importance of the reference system in evaluating the climate effects of bioenergy. It will develop the concept that policy makers have different needs (for example, implications of a policy or selection of a particular bioenergy technology within a policy) hence the reference system should be selected to meet these requirements.

Metrics for quantifying climate effects of bioenergy
Also arising from the two expert meetings in 2014 is a paper that will discuss the implications of different metrics in evaluating the climate impacts of bioenergy. We generally use greenhouse gas emissions (using GWP_{100} to combine impacts of different gases) as the indicator, but other indicators such as radiative forcing or global temperature potential could be used. These metrics include other climate forcing factors such as changes in surface albedo.

Updating the Standard Methodology
The standard methodology for calculation of GHG emissions for different bioenergy systems developed by Task 38 has to be up-dated as new issues emerge. The task is currently working on a paper which will give information on how to integrate new topics such as the timing of forest based GHG emissions, land use change impacts and non-greenhouse gas effects (e.g. albedo effect) and how to deal with e.g. harvested wood products. The completion of the paper is postponed until the metrics and reference system papers are complete, as it will refer on these.

Comparison of Major Life Cycle Assessment Models
Several papers are under preparation addressing: (1) models and practices used in policy implementation for GHG emissions in Europe, United States, and Canada; (2) other environmental impacts for commercial biofuels; and (3) prospective models used in conjunction with technology development evaluation. Topic (1) will be used, in conjunction with Task 39, to prepare a short IEA report explaining differences reported in the various IEA and IEA Bioenergy task reports.

2. Inter-task Projects

Joint workshop on Forests, bioenergy and climate change mitigation, Copenhagen, May 19-20, 2014 (see also above)
Tasks 38 joined Tasks 40, 43, the European Commission's Joint Research Centre, the European Environment Agency and the International Institute for Sustainability Analysis and Strategy in devising and presenting this workshop which brought together researchers with a range of views on the role of forest-based bioenergy in contributing to climate change mitigation. The workshop was successful in encouraging dialogue between experts with

divergent views, clarifying the basis for these views, and identifying points of convergence, particularly related to the appropriate approaches for assessing the climate effects of bioenergy, and priorities for research.

Mobilising sustainable bioenergy supply chains
Task 38 is collaborating in this large project led by Task 43, and is contributing to several of the supply chain case studies. Annette Cowie is a member of the Coordination Committee for this Inter-task Project. Helena Chum has provided input to the case study on agricultural residues, which will include an assessment of the GBEP indicators. Alison Goss Eng is collaborating with Niclas Scott on this component. Regis Leal is providing input to the component of the project that focuses on ethanol from sugar cane in Brazil. Task 38 will provide input on the climate change effects of each of the supply chains.

3. Next Meeting

The next Task 38 Business Meeting will be held in Sweden in May 2015.

Website/Communication

Task Website

A new website has been created (www.task38.org) and is now the repository of all current and/or relevant resources from the previous Joanneum site (Austria is not a current Task 38 member).

Information on the new site includes:

- Documentation from Joint workshop on Forests, bioenergy and climate change mitigation, Copenhagen, May 19-20 2014: workshop statement, background documents, presentations, summary of discussion
- presentations from all previous Business Meetings and Workshops
- case studies (identified by both country and process)
- publications of Task 38
- journal publications of Task38 members
- Guidance on methods for quantifying greenhouse gas balance of bioenergy systems
- FAQ page
- list and contact details of member countries and delegates.

Collaboration with Other Tasks

Joint workshop: Forests, bioenergy and climate change mitigation, Copenhagen, May 19-20, 2014 (see above)

Inter-Task projects (see above).

Within the inter-Task project "Mobilising sustainable bioenergy supply chains" (a collaboration of Tasks 43, 42, 40, 39 and 38) Task 38 will demonstrate the utility of the updated standard methodology by assessing case studies from participating countries. Task 38 will also work with Tasks 34, 37, 39 to review GHG assessment for fast pyrolysis processes, energy from biogas, and contribute to a review of algae biofuels.

Joint presentations

Berndes, G., Cowie, A., Smith, C., Chum, H., Gustavsson, L., Pingoud, K., Kline, K. (2014). Perspectives on Quantifying the Benefits of Forest-Based Bioenergy. 22nd European Biomass Conference and Exhibition, Hamburg, Germany, 23-26 June, 2014

Cowie, A., Berndes, G. (2014). Quantifying the climate change effects of forest-based bioenergy: dealing with time. 3rd New Zealand Life Cycle Assessment Conference 2014. Life Cycle Thinking and Policy: Towards a Sustainable Society. September 2-3, 2014, Wellington

Cowie, A., Berndes, G. (2014). Quantifying the climate change effects of forest-based bioenergy: dealing with time. Bioenergy Australia conference. December 1-2,2014, Adelaide.

Joint publications:

Pelkmans, L., L. Goovaerts, C. Goh, M. Junginger, J. van Dam, I. Stupak, C. T. Smith, H. Chum, O. Englund, G. Berndes, A. Cowie, E. Thiffault, U. Fritsche and D. Thrän (2014). The Role of Sustainability Requirements in International Bioenergy Markets. In International Bioenergy Trade: History status & outlook on securing sustainable bioenergy supply demand and markets. Series: Lecture Notes in Energy Vol. 17, Junginger M., Goh C. S., Faaij A. (Eds.) pp. 125-149, ISBN: 978-94-007-6981-6.

Schweinle, J., Rödl A., Börjesson, P., Neary, D.G., Langeveld J.W.A., Berndes, MG., Cowie, 2015. Assessing the Environmental Performance of Biomass Supply Chains. IEA Bioenergy Task 43 Report 2015:TR01 http://www.ieabioenergytask43.org/wp-content/uploads/2015/02/IEA-BIOENERGY-TR2015-01i-.pdf

Stupak, Inge; Jamie Joudrey; C. Tattersall Smith; Luc Pelkmans; Helena Chum; Annette Cowie; Oskar Englund; Chun S Goh; Martin Junginger. "A global survey of stakeholder views and experiences for systems needed to effectively and efficiently govern sustainability of bioenergy", Wiley Interdisciplinary Reviews: Energy and Environment.

Networking

4. Task 38 Workshop: Helsinki, Finland, December 9

Task 38 organised a one-day workshop with invited Finnish and Swedish forest modelling experts on "Forest-based Bioenergy" at Congress Paasitorni, Helsinki. The ten presentations covered both economic and ecological approaches to model forest carbon impacts. According to economic modelling exercises presented, pricing of the sequestered carbon would significantly influence economically optimal forest management. However, there are trade-offs between short and long term climate benefits, and also between bioenergy and other ecosystem services (such as biodiversity). More intensive harvesting of wood reduces forest carbon stocks temporarily compared to less intensive harvesting. At the end, the climate impacts of forest bioenergy are highly dependent on the selection of the baseline scenario, choice of the time horizon, parameter setting and metrics applied. Task 38 contributions in the session were:

- Sampo Soimakallio (Finland): chair
- Annette Cowie (Australia): *Welcome and introduction to Task 38*
- Miguel Brandão: *Ensuring carbon balances in the modelling of forest and bioenergy systems*

Networking with bioenergy-relevant multilateral organizations' projects

Task 38 contributed expert authors and reviewed a journal paper resulting from the IPCC 5th assessment Report Working Group 3 Report on Agriculture, Forestry and Other Land Use:

> F. Creutzig, N. H. Ravindranath, G. Berndes, S. Bolwig, R. Bright, F. Cherubini, H. Chum, E. Corbera, M. Delucchi, A. Faaij, J. Fargione, H. Haberl, G. Heath, O. Lucon, R. Plevin, A. Popp, C. Robledo-Abad, S. Rose, P. Smith, A. Stromman, S. Suh, O. Masera 2014. Bioenergy and climate change mitigation, Global Change Biology: Bioenergy, doi: 10.1111/gcbb.12205, 29 pages. Top 15 most downloaded publication of 2014 in this journal (published 7/4/2014).

IEA Bioenergy experts, including from Task 38, contributed to the development of the SCOPE (Scientific Committee on Problems of the Environment, http://www.scopenvironment.org/) Project:

Bioenergy and Sustainability: Bridging the Gaps, led by the Brazilian Research Foundation. During 2014 an electronic book publication was prepared which will be released in April 2015 (http://bioenfapesp.org/scopebioenergy/).

Deliverables

Apart from the wide range of deliverables mentioned above, the Task also produced progress reports and audited accounts for the ExCo, and minutes of the Task meetings. In addition, individual task members published scientific papers that were informed by interactions with Task members, and some of these outputs were formally reviewed by Task 38 members.

TASK 39: Commercialising Conventional and Advanced Liquid Biofuels from Biomass

Overview of the Task

The goal of Task 39 is to support the commercialisation of liquid biofuels from biomass, with a primary focus on conventional and advanced technologies, but with a mandate that includes 'next-generation' fuels (for example, algal and 'drop-in' biofuels). Through a coordinated focus on policy and technical aspects, the Task assists participants in their efforts to develop and deploy biofuels, including ethanol from lignocellulosics, Fischer-Tropsch fuels, and biomass-to-liquid (BTL) biosyndiesel (biodiesel made from synthesis gas), etc. It also continues to identify and facilitate opportunities for comparative technical assessment and support for policy development. The success of the Task has been, in large part, a direct result of providing a forum for these types of integrated discussions, with the active involvement of participants from industry, government and academia. The Task objectives are to:

- Catalyse cooperative research and development projects to help participants:
  - develop and commercialise improved, cost-effective bio-based processes for the generation of advanced biofuels, particularly biomass to biofuels;
  - work with other Tasks to develop and commercialise improved, cost-effective thermochemical-based processes, such as pyrolysis-based fuels and the Fischer-Tropsch process for converting syngas to synthetic biodiesel and other advanced biofuels; and
  - understand advancements in 'next-generation' liquid biofuel technologies, including biomass-to-hydrogen, algae-to-biofuel processes, and the development of so-called 'drop-in' biofuels.
- Provide information and analyses on policy, markets, and implementation issues (including regulatory and infrastructure development) that will help participants encourage commercialisation of liquid biofuels as a replacement for fossil-based biofuels, by continuing the deployment of conventional (so called first generation) biofuels and supporting development of advanced (so called 2nd generation) biofuels and (potentially) 'next-generation' biofuels.
- Provide information dissemination, outreach to stakeholders, and coordinate with related groups both within IEA Bioenergy and externally.

The Task structure allows participants to work together in the broad area of liquid/transportation biofuels in a comprehensive manner.

Participating countries: Australia, Austria, Brazil, Canada, Denmark, Germany, Italy, Japan, South Korea, the Netherlands, New Zealand, Norway, South Africa, Sweden, and USA

Task Leader: Dr Jim McMillan, NREL, USA

Co-Task Leader: Dr Jack Saddler, University of British Columbia, Canada

Operating Agent: Mr Ed Hogan, Natural Resources Canada, Canada

The Task leadership is shared between the National Renewable Energy Laboratory (USA) as represented by Jim McMillan, and the University of British Columbia (Canada) as represented by Jack Saddler. Both Task Leaders are engaged in all aspects of the Task's operations. The Task leaders are assisted by several Sub-Task Leaders who help with both the Technology and Commercialisation, and Policy, Markets and Implementation aspects of the Task. The Task leadership is assisted by Dr Susan van Dyk (UBC), who acts as Editor of the Task Newsletter and Webmaster. Dina Bacovsky (Austria) manages the demonstration plant database. Jurgen Krahl has been acting as the liaison person with the Advanced Motor Fuels Implementing Agreement. A National Team Leader for each country is responsible for coordinating the national participation in the Task.

For further details on Task 39, please refer to Appendices 2, 4, 5 and 6; the Task website (www.Task39.org) and the IEA Bioenergy website (www.ieabioenergy.com) under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

Task 39 remains highly active in terms of both business meetings (which involve significant knowledge exchange between participants in the form of Country Reports) as well as special sessions hosted in conjunction with established biofuels events. In 2014, the Task held two business meetings in Berlin, Germany in January 2014 and in Copenhagen, Denmark in May 2014.

The first business meeting took place on 22 January, 2014 in Berlin, Germany, in conjunction with the "Fuels for the Future" conference. The business meeting took place immediately after the main conference and most of the member countries attended the meeting. The full day business meeting covered country updates on the status of biofuels in the majority of Task 39 member countries and reviewed progress on the various completed and planned deliverables for the Task during the 2013-2015 triennium. Plans were also updated for upcoming

workshops, symposia and meetings that the Task 39 network will organise or participate in during this new triennium. Ulrike Heckenberger from the Airbus Group gave a presentation at the business meeting. The Fuels for the future conference was attended by participants from around the world and included two dedicated sessions organized by IEA Bioenergy Task 39. The Task 39 sessions within the conference featured a total of 10 presentations given by Task 39 members; one session focused on the policy tools used to help develop biofuels and the other focused on technical and commercialization progress in the advanced biofuels area.

The business meeting was followed by a joint workshop with Task 42 (Biorefineries) to explore increased collaboration between the two Tasks. A presentation was given by Task 39's Gisle Johansen (Senior Vice President R&D, Borregaard), using many excellent examples of issues, strategies and lessons learned from Borregaard's history of commercial biorefining of primarily softwood feedstocks. Task 42's Gerfried Jungmeier (Joanneum Research Institute) followed with an overview of the Task 42 network's various activities, with a particular focus on the fact sheets used to summarize biorefinery coproduct slates that could be produced using specific biorefinery configurations. These two overview talks provided the combined group with a good foundation for brainstorming future joint work activities.

In May 2014, Task 39 held a business meeting in conjunction with the IEA Bioenergy Executive Committee (ExCo) meeting in Copenhagen. An informative workshop entitled, "Infrastructure compatible transportation fuels", was jointly organized by IEA Bioenergy and the Advanced Motor Fuels (AMF) implementation agreements (IA). Two Task 39 colleagues, Oliver May (DSM) and Sergios Karatzos (UBC/Steeper Energy) gave presentations, respectively providing an industrial perspective and summarizing the Task's recently released report on drop-in biofuels. Following the workshop, Task 39's biannual business meeting was hosted at the University of Copenhagen by Professors Claus Felby (U. Copenhagen) and Henning Jorgensen (Technical University of Denmark) and focused on assessing progress across the Task's various ongoing activities. In addition, Anselm Eisentraut from IEA Headquarters generously joined the meeting and provided an overview of the original assumptions and targets that were used to develop the IEA HQ Biofuels 2050 Roadmap predictions that generated considerable discussion. In the past, through their multi-country expertise and varying perspectives, Task 39 members have played a valuable role to IEA HQ by providing data, assessing technology claims and identifying potential pitfalls that could otherwise detract from the integrity of the IEA's different biofuel predictions. IEA HQ recognizes that some assumptions in the original report have changed such that an update of the 2050 road map may be warranted.

The excellent participation of most country team leaders at many of the Task 39 meetings would seem to confirm the value that the network plays in facilitating excellent information exchange.

Work Programme

The programme-of-work for the Task included the following elements:

Providing Information on Policy, Regulatory, and Infrastructure Issues

The overall objective of this component of the Task is to provide governments and policy makers with information that will help them identify and eliminate non-technical barriers to liquid biofuels deployment.

The Task continues to compile country-specific information on biofuels including fuels usage, regulatory changes, major changes in biofuels policies, and similar items. The purpose of this effort is to maintain the Task's role as a central source of relevant information on biofuels. The business meetings allocate time for country representatives to present updates on developments in their respective regions. Country report presentations along with the meeting minutes and other presentations from the business meetings are posted in the 'members only' section of the Task website.

Information dissemination and communication to the biofuels community in general takes place through presentations made in Special and/or Parallel sessions at established biofuels events occurring in close conjunction with scheduled business meetings, as well as through Task 39 members receiving invitations as plenary speakers at conferences.

Technical Aspects of Lignocellulosic Biomass-to-Ethanol Processes

The Task provides an information exchange network for participants who are conducting research and development activities in the area of lignocellulosic biomass-to-ethanol.

The working group in this area is primarily focused on the technical and economic aspects of biomass-to-biofuels. The Task continues to update the database on advanced biofuels facilities (coordinated by our Austrian colleagues). This database provides up-to-date information on over 100 companies which includes biochemical, thermochemical, and hybrid conversion approaches to producing biofuels. However, it is difficult to obtain detailed and accurate information from many of the companies as the various processes approach commercialisation and companies understandably want to protect their proprietary information.

Another study to which Task 39 has contributed is the IEA Bioenergy special inter-Task project entitled, "Mobilizing Sustainable Bioenergy Supply Chains". This project is being led by Task 43 (Feedstocks). Task 39 has provided a chapter to the report which will eventually be published in book form. The Task 39 contribution is entitled "Challenges and opportunities for the conversion technologies used to make forest biomass based bioenergy/biofuels" (Cadham, W.J., Van Dyk, J.S., Kumar, L., Saddler J.N.).

Major Reports

Two major reports were completed during 2014 and are summarised below:

a) The Potential and Challenges of Drop-in Biofuels

The Task 39 report on "The potential and challenges of drop-in biofuels" (T39-T4) completed an internal review process and was made publicly available for download from the Task 39 website in 2014 (www.task39.org). To paraphrase the Executive Summary of the report, "Due primarily to the significant processing and resource requirements (e.g., sufficient hydrogen supply and effective catalysts) needed to make drop-in biofuels as compared to "conventional" oxygenated alcohols or FAME biofuels, large scale, large volume production of cost-competitive drop-in biofuels is expected to remain challenging in the near-to-midterm". The report describes and classifies "drop-in" biofuels and provides an early stage assessment of the technical and commercial potential of a variety of these biofuels. This was done by examining leading technology platforms and company strategies as well as relevant market and policy trends. Technological issues or gaps that must be overcome to realize the "commercialization potential" of various "drop-in" biofuels were assessed and described.

b) Report on Implementation Agendas

Task 39 finalised its periodically updated biofuel "Implementation Agendas" report that compares and contrasts developments in biofuels production and market penetration for 19 different countries. These countries include the Task 39 member countries as well as important emerging economies such as China and India for completeness and comparison. The report includes details of biofuel policies and the extent to which these biofuels policies have been implemented. The report also assessed the measures taken by member countries to develop or stimulate their respective biofuels industries, including incentives and investment in research. The report also provides updates on the current status of biofuel sustainability assessments and related discussions that factor into policy development. To make the report more uniform and comparable in future a template will be provided to the country representatives to gather information from member countries.

This comparison between each country's policies highlights the diversity of drivers being used, which vary from energy security concerns (USA) to reducing net greenhouse gas emissions (EU). The amount of biomass available within different countries varies widely, with some countries having abundant biomass resources available for biofuel development (e.g., USA, Brazil), while others have a limited supply of such biomass resources available (e.g., Japan, China). This affects the growth and development of biofuels in these jurisdictions. Under conditions of limited biomass supply, these resources may preferentially be used for alternate forms of energy, such as electricity generation. In most countries the production of advanced biofuels, such as cellulosic ethanol and drop-in fuels, is making slower-than-hoped-for progress. However, although the pace of commercialisation of most of the biomass-to-liquid biofuels

technologies is slower than previously forecast, several demonstration- and commercial-scale plants in Task 39 member countries are expected to become fully operational this year. Continuity of some of the more successful policy drivers already put in place to catalyse advanced biofuels commercialisation is essential to maintain or increase the rate of technology development and commercialization.

This report is available on the Task 39 website but only members have access.

Newsletter

The Task published three newsletters in 2014 (featuring the country reports of the USA, Brazil and The Netherlands). The newsletters provide information about the Task activities and international events related to biofuels. The newsletter has an active distribution list of nearly 3,000 individuals worldwide and copies are routinely downloaded from the Task website.

Website

The Task continues to build on its already considerable influence on the international community working in the liquid biofuels area. The recently redesigned website (www.Task39.org) and the newsletter have had very positive reviews. The website is frequently visited/cited and enquires are typically handled by the Task coordinators and webmaster, or referred to experts within the Task 39 network.

Collaboration with Other Tasks/Networking

The Task has on-going interactions with the other Tasks, IEAHQ, other Implementing Agreements (AMF) and with external groups such as USDOE, the Global Bioenergy Partnership and the FAO.

Deliverables

The deliverables for the Task in 2014 included: organisation of several meetings throughout the year; two progress reports and audited accounts (as required by ExCo); development and maintenance of the Task 39 website; three newsletters and two reports. The full library of Task reports, country specific reports, etc. are available through the Task website (www.Task39.org). These are detailed in Appendix 4.

TASK 40: Sustainable International Bioenergy Trade: Securing Supply and Demand

Overview of the Task

There is increasing need to develop biomass resources and exploit biomass production potentials in a sustainable way and to understand what this means in different settings. Biomass markets are still immature and vulnerable, and this is particularly true for the demand side of the market. Many biomass markets, e.g. solid biofuels, rely on policy support and incentives. It is important to develop both supply and demand for biomass, and energy carriers derived from biomass, in a balanced way and to avoid distortions and instability that can threaten investments in biomass production, infrastructure and conversion capacity. Understanding how this is best organised and managed needs further investigation. International biomass markets have been mapped by the Task, but the analyses, statistics, and modelling exercises undertaken so far still have limitations.

The core objective of the Task remains 'to support the development of a sustainable, international, bioenergy market, recognising the diversity in resources, and biomass applications'. Developing a sustainable and stable, international, bioenergy market is a long-term process. The Task aims to provide a vital contribution to policy making decisions by market players, policy makers, international bodies, and NGO's. It will do this by providing high quality information and analyses, and overviews of developments. It will also provide a link between different sectors, and act as a clearing-house for information through targeted dissemination activities.

The Task Leaders direct and manage the work programme. National Team Leaders from each country are responsible for coordinating the national participation in the Task.

Participating countries: Austria, Belgium, Brazil, Denmark, Finland, Germany, Italy, the Netherlands, Norway, Sweden, United Kingdom, and USA.

Task Leader (Scientific): Dr Martin Junginger, Copernicus Institute, Utrecht University, the Netherlands

Task Leader (Industry): Mr Peter-Paul Schouwenberg, RWE, the Netherlands

Operating Agent: Ir Kees Kwant, NL Enterprise Agency, The Netherlands

For further details on Task 40, please refer to Appendices 2, 4, 5 and 6; the Task website (www.bioenergytrade.org) and the IEA Bioenergy website (www.ieabioenergy.com) under 'Our Work: Tasks'.

Task Meetings and Workshops

The Task organised several workshops in 2014. The programme and presentations (and in some cases summaries) can be downloaded from the Task website: www.bioenergytrade.org.

In January, Task 40, Task 32 and SECTOR jointly organised a workshop *"Torrefaction of Biomass"* at the 4th Central European Biomass Conference in Graz, Austria. The workshop attracted 70 attendees to the discussion of economic and technological developments in the field of biomass torrefaction. The workshop started with an overview of the developments in torrefaction, followed by several technical presentations on the torrefaction process, and also topics on international trade and market perspectives. Finally, the workshop ended with a round table discussion on the future perspectives from the viewpoints of technology suppliers, biomass producers, traders and consumers.

In May, Task 40 contributed to the organisation of the two-day joint workshop on "Forests, bioenergy and climate change mitigation" in Copenhagen, Denmark, with Tasks 38, 43, IINAS, EEA and JRC (see tasks 38 and 43 for further details).

In June, a workshop was organized by Task 40 on *"Biomass trade & supply system opportunities in a world-wide bio-based economy"* at the World Bioenergy Conference 2014 in Jonkoping, Sweden. This workshop was framed by the growing worldwide interest to transition from fossil energy resources such as oil and coal to renewable, bioenergy resources. The shift is complex, and the process varies depending on many influences, such as regional resource availability, logistics and distribution infrastructures, and specific product opportunities/demand. Depending on the type and size, biorefineries may be placed either near the feedstock, or near demand centres. The workshop discussed the potential international supply, trade, and demand for biomass for energy, fuels, and chemicals applications within a competitive energy market, including the impact/opportunities associated with improved and new value chains (e.g. conversion technologies and end uses).

In October, the International workshop *Towards sustainable international biomass trade strategies* in Brussels, Belgium was organized jointly by Task 40 and Biotrade 2020+. Today in the European Union, the cost-effective achievement of existing and future bioenergy targets set in the legislation implies that in addition to using domestic sustainable and cost-competitive biomass potentials, European markets will also (partly) rely on sustainable and cheap(er) imports of biomass. Some well-positioned regions of the world are already playing a role in supplying biomass to the European markets and could become increasingly relevant in the near future. One of the objectives of the BioTrade2020+ project is to propose appropriate long-term strategies and support frameworks which can form a basis for a balanced approach between promoting the use of domestic biomass, while also keeping markets open for sustainable imports of biomass. This workshop brought experts together to initiate discussions on how these trade strategies can be framed. The central points of discussion were (1) how to define sustainable export potentials, (2) which opportunities and risks were connected with biomass trade and how these could be addressed, and (3) which were the key principles that sustainable biomass trade should fulfil – one important point was the interaction between local use and exports in the sourcing regions.

In addition to these workshops and meetings, Task 40 also held business meetings in Graz, Austria in January; in Lappeenranta, Finland in June; and in Brussels, Belgium in October to discuss current projects, including the progress of several studies and the planning of the work programme for the new triennium.

Future Meetings and Workshops

After a workshop on biogas (jointly with Task 37) in Berlin in January 2015, the next meeting of Task 40 in 2015 is scheduled in May 2015, and will be held in Sardinia, Italy, linked to a joint workshop with Task 42. Task 40 will also organize a workshop in Riga in April as part of the Nordic Baltic Bioenergy conference. The final meeting is planned to be in Berlin, Germany in October 2015 along with the IEA Bioenergy Conference.

Work Programme and Outputs

As outlined in the 2013-2015 work programme, the core objective of the Task is: 'to support the development of sustainable, international bioenergy markets and international trade, recognising the diversity in resources and biomass applications'. The proposed work programme consists of the following five topics:

1. Mobilisation of sustainable biomass resources for the international market across different regions in the world.
2. Analysis of the future market demand for biomass from the broader biobased economy perspective.
3. Sustainability and certification.
4. Support of business model development for biomass supply and value chains.
5. Assisting the development and deployment of advanced analysis tools to improve the understanding of potential future market developments, implications and impacts of policies.

In 2014, the Task produced a number of significant deliverables. All reports are available for free download from the Task 40 website www.bioenergytrade.org.

Report(s): Impact of promotion mechanisms for advanced and low-iLUC biofuels on markets (Topic 3)

With current discussions on indirect effects of biofuels, and the aim to broaden feedstocks to non-food biomass, policies are trying to put focus on biofuels from waste, residues and lignocellulose materials, so called 'advanced' biofuels. Next to the general biofuel incentives, these biofuels are getting extra support through specific promotion mechanisms. Examples are the double-counting mechanism for advanced biofuels in the EU, and the specific targets for advanced biofuels in the US. In this study, some typical cases are presented where promotion mechanisms for advanced biofuels have had an impact on markets and trade (used cooking oils and animal fats, sugarcane ethanol), or may be anticipated to impact markets and trade in the future (straw, wood pellets). General conclusions and summaries of the four case studies can be found in a summary report.

The selected cases are:

1. Used cooking oils and animal fats for biodiesel: impact of the double-counting mechanism for advanced biofuels in the European Renewable Energy Directive on market prices and trade flows, analysed for the Netherlands and Italy. Download report.
2. Sugarcane ethanol: impact of the subtargets for specific advanced biofuels in the US Renewable Fuels Standard (RFS2), where sugar cane ethanol is classified as 'advanced biofuel'. This has had a clear impact on prices and trade patterns between Brazil and the US. Download report.
3. Crop residues (straw) for bioenergy: straw may play an important role for advanced biofuels in the future. In countries such as Germany, Denmark or Poland, this is an emerging feedstock for energy and biofuels. There are already some experiences we can take into account from the promotion of straw for stationary energy, e.g. in Denmark. Download report.
4. International trade of US wood pellets for bioenergy in the EU: Renewable Energy promotion in certain EU Member States is causing considerable trade flows from the US to the EU. There is clear that there are interactions with existing wood markets and forestry practises. In the future there may be additional effects when demand for cellulose-based biofuels enters these markets. Download report.

Report: Biomethane – Status and Factors Affecting Market Development and Trade (Topic 4)

A new report, "Biomethane: Status and Factors Affecting Market Development and Trade", published in September 2014, was prepared jointly by Task 40 and Task 37 to address the status and emerging challenges of dealing with the rapid growth of production of biomethane, by either anaerobic digestion or thermal gasification, the developing biomethane market and trade of the gaseous biofuel. The aim of this study is to provide an up-to-date overview of the status of biomethane (including upgraded biogas and bio-SNG) production, grid injection and use in different countries, and to illustrate the options and needs for the development of larger biomethane supply strategies. The focus is on technical, economic and management-related hurdles to inject biomethane into the natural gas grid and to trade it transnationally. The study provides insights into the current status of technologies, technical requirements and sustainability indicators as well as cost of biomethane production and use in general and especially in selected countries. It also assesses implementation strategies, market situations and market expectations in selected countries, and proposes actions to be taken to reduce barriers and to develop the market step-by-step.

Report: Ecological sustainability of wood bioenergy feedstock supply chains: Local, national and international policy perspectives (Topic 3)

The report first provides a brief overview of development of policy and criteria related to sustainability of bioenergy in the EU and in key biomass importer Member States (United Kingdom, the Netherlands and Belgium). The following sections then provide a thorough

review of policy, regulations and practices of Canada and the United States, with a special focus of key biomass producing provinces/states (British Columbia, Ontario and Quebec in Canada, Georgia, New York, Massachusetts and California in the US); this in-depth analysis of the Canadian and American contexts was made possible due to the abundance of information available for those countries, but was also found necessary due to the scarcity of syntheses on this information. The next section then provides an overview of the policy and practices for land and forest management in Russia, with a focus on the region of Northwest Russia, based on the information that was possible to gather from this area. The report concludes with a discussion and main conclusions stemming from the analysis of the case studies.

Workshops

In addition to written deliverables, workshops were linked to the work programme objectives as follows:

- The workshop in Graz was linked topic 2, 4 and 5.
- The workshop in Jonkoping was related to topic 1, 2, 4 and 5.
- The workshop in Brussels covered topic 1, 2, 3 and 5.

On-going and New Topics (2014-2015)

The projects listed below are all currently ongoing and will be finalized over the course of 2015.

- ***Report on the ongoing developements for torrefaction of biomass:*** Torrefaction as an industry is still in its early stages. Obviously the nature of such early stage industries and the overall sector are very dynamic and changes are to be observed almost continuously. Task 40 has produced a Torrefaction Report in the last triennium. Since then the technology has developed further, the knowledge basis was extended, combustion experience has been gained and there are some changes within the group of active companies. This projects aims to provide an update of the technology status overview as well as a deeper analysis of the trading side by looking into transportation and the issues coming up when physically moving torrefied biomass between trading partners is going to be implemented. Torrefaction in its earlier days was a sector focusing almost completely on coal power plants as target product consumers. Torrefied biomass will have plenty of other applications. These other applications may even be more important to the sector in the coming years when probably only small to medium production capacities will be in operation. A further look into some of the other potential consumer groups, describing their needs and expectations is intended as well.
- ***Task 40 & 42:*** Biomass Trade and Supply System Opportunities for a Global Bio-Based Economy: The future vision for global bioenergy trade is that it develops over time into a real 'commodity market'. Investigating the requirements (pre-conditions) for a commoditization of biomass and biofuels will play a central role in this report.

It specifically covers (1) an in-depth historical analysis of the developments of existing key commodity markets, e.g., of the energy (e.g., coal) or food/feed sector (e.g., corn), and (2) an exploration of how conditions can be created and enhanced to achieve the same for biomass and biofuels resources. The report will assess the potential international supply, trade, and demand of biomass for energy, fuels, and chemicals applications within a competitive (energy) market, including the identification of improved and new value chains (e.g., conversion technologies and end uses). The assessment will include current state-of-the-art overviews of the markets for power, heat, and fuels/chemicals, and the identification and characterization of emerging biomass demand regions. The ultimate aim will be to integrate the market demand assessment and specification analysis to form a larger picture of the implications of developing a bio-based economy for biomass supplies and trade at the international level. This can include the identification of new or improved value chains and integration of biomass into existing large-scale logistics infrastructure.

- ***Modelling price trends for bioenergy markets:*** Due to increasing demand for bioenergy, trade of bioenergy products is expected to grow many-fold over the coming decades. With bioenergy products on the brink of becoming global standardized and fungible goods, also more mature financial market mechanisms are likely to develop for trade of these commodities. Major energy commodities, like oil and gas, are traded as futures contracts on international exchanges. Although only a fraction of the globally traded volume is exchange-based, the settlement prices from futures markets are an important signal for all market actors. While a futures contract specifies a trade taking place in the future, the purpose of the exchange is to act as intermediary and minimize the risk of default by either party. The difference in the prior agreed-upon price and the actual futures price can be used to hedge risks in a volatile market. Thus hedging by futures contracts can reduce any substantial losses and gains, especially in the case of large scale actors like utilities, financing institutions or the energy industry, and is to date common practice for many consumers of fossil energy products. Consequently, a decision support tool for price trends on bioenergy futures markets can not only help to reduce risks, but enable gaining a major advantage on the market. Success in building a model that can forecast bioenergy prices would mean that a range of bioenergy utilities, the financial community and interested experts from the scientific modelling community could actively engage in hedging their risks, invest in bioenergy markets with an expected rate of return and understand driving factors of bioenergy prices on futures markets. The central aim is thus to describe existing bioenergy price indices and identify driving factors and correlations in price development of bioenergy commodities that can be used to increase forecasting accuracy, prove the feasibility of a bioenergy price model and develop an accurate, tested model for both a liquid and a solid bioenergy market.

Website

The Task website is a key tool for dissemination of information. In 2014, the number of hits has increased to about 592,000 from 570,000 in 2013. Meanwhile, the host has changed to a new method in calculating number of visits since May 2014, so that it is not possible to compare with the numbers of previous years. In 2014, the unique visitors ranged between 1,000 – 2,000 per month. The amount of monthly downloaded data has been continuously increasing over the past 9 years, from 19 GB/month in 2012 to > 30 GB/month in 2014. There were 17 documents which were downloaded more than 1,000 times, and 35 documents more than 500 times. In 2014, the report "Global Wood Pellet Study (2011)" has been downloaded 11,800 times, and being viewed online over 377,000 times. This is followed by the report "A Global Overview of Vegetable Oils, With Reference To Biodiesel (2009)" with almost 9000 downloads and more than 42,000 online views. In 2014, one Task 40 newsletter was circulated to about 1,400 subscribers. All Task deliverables (e.g., country reports, market studies, etc.) and presentations given at the Task workshops are available for downloading.

Collaboration with Other Tasks/Networking

As described above, events were organised jointly with Task 32, 38 and 43. At these events, the work of the Task was disseminated via presentations. The Task's work was also presented to a large number of other audiences during 2014, such as the workshops (jointly) organized by Task 40 with many other parties like SECTOR in Graz, World Bioenergy Conference at Jonkoping, and Biotrade 2020+ in Brussels. Task 40 will continue this effort in 2015, collaborating with Task 37 in January 2015, with Svebio in April 2015 and with Task 42 to organize a workshop on the bio-based economy in Sardinia, Italy, in May 2015. Task 40 has conducted a number of studies in cooperation with other task. The Task will continue this outreach and collaboration in 2015.

Deliverables

Deliverables in 2014 included 3 workshops, various types of reports, several market studies, 1 newsletters (circulation of 1400), minutes from three Task meetings, two progress reports and audited accounts to the ExCo; plus several presentations at various international workshops and conferences. These are detailed in Appendix 4.

TASK 41: Bioenergy Systems Analysis

Overview of the Task

The objective of the Task is to supply various categories of decision makers with scientifically sound and politically unbiased analyses needed for strategic decisions related to research or policy issues. The target groups are particularly decision makers in Ministries, national or local administrations, deploying agencies, etc. Depending on the character of the projects some deliverables are also expected to be of direct interest to industry stakeholders. Decision makers, both public and private, have to consider many aspects, so the Task needs to cover technical, economic, and environmental data in its work. The Task's activities build upon existing data, information sources, and conclusions. It does not intend to produce new primary scientific data.

The Task differs from the other Tasks in that it does not have networking as one of its prime objectives, nor do the Task's activities have continuous and repeating components, e.g., biannual meetings, country updates, etc. The work programme has a pronounced project emphasis with each project having very specific and closely defined objectives. Because of its special character in terms of participation, financing and cross-cutting orientation, the Task aims to become a valuable resource and instrument to the ExCo serving the ExCo with highly qualified resources to carry out projects, involving several parties (e.g., other Tasks and organisations) as requested by the ExCo. Due to the close contact with the other Tasks, Task 41 is intended to develop into a platform for joint Task work and a catalyst for proposals from the Tasks to the ExCo.

A project leader directs and manages the work of each project. For new projects an appropriate project leader is appointed by the project participants acting through the Executive Committee. The ExCo Member from each participating country acts as the national Team Leader and is responsible for coordinating national input to the projects undertaken.

For further details on Task 41, please refer to Appendices 2, 4 and 5; and the IEA Bioenergy website www.ieabioenergy.com under 'our Work: Tasks'.

Progress in R&D

Work Programme

The work programme is comprised of a series of projects. Each project has its own budget, work description, timeframe, and deliverables and is approved by the participants. The focus is on the needs of the participants by way of project outputs. Four projects have been initiated and completed to date. Details are:

Project 1: Bioenergy – Competition and Synergies

Participating Countries: Germany, Sweden, United Kingdom, USA and the European Commission

Project Leader: Mr Sven-Olov Ericson, Ministry for Sustainable Development, Sweden

Operating Agent: Dr Björn Telenius, Ministry of Enterprise, Energy and Communications, Sweden

Status: Completed in December 2008

Project 2: Analysis and Identification of Gaps in Fundamental Research for the Production of Second Generation Liquid Transportation Biofuels

Participating countries: Finland, the Netherlands, Sweden, United Kingdom, USA and the European Commission

Project Leader: Dr Michael Ladisch, Purdue University, USA

Operating Agent: Mr Paul Grabowski, US Department of Energy, USA

Status: Completed in July 2008

Project 3: Joint project with the Advanced Motor Fuels Implementing Agreement, Annex XXXVII 'Fuel and Technology Alternatives for Buses: Overall Energy Efficiency and Emission Performance'

Participating countries: Finland, Germany and the European Commission

Project Leader: Professor Kai Sipilä, VTT, Finland

Operating Agent: Professor Kai Sipilä, VTT, Finland

Status: Completed in September 2012

Project 4: Joint project with the Advanced Motor Fuels Implementing Agreement, Annex XXXIX 'Enhanced Emission Performance and Fuel Efficiency for Heavy Duty Methane Engines'

Participating countries: European Commission and Norway

Project Leader: Dr Kyriakos Maniatis, European Commission, Belgium

Operating Agent: Professor Kai Sipilä, VTT, Finland

Status: Completed in May 2014.

Deliverables

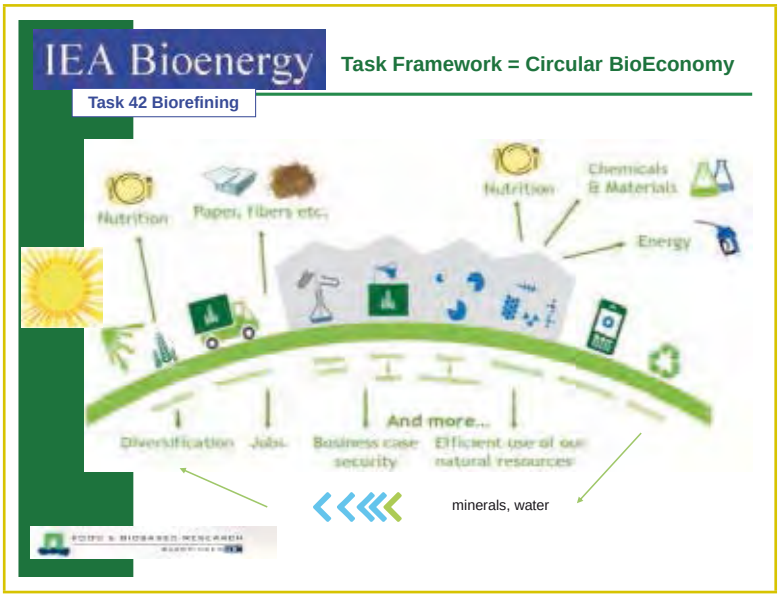
The deliverables may consist of progress reports and financial accounts to the ExCo, and a final report on each project – see details in Appendix 4.

TASK 42: Biorefining: Sustainable Processing of Biomass into a Spectrum of Marketable Bio-based Products and Bioenergy

www.iea-bioenergy.task42-biorefineries.com

Overview of the Task

In a future bio-economy sustainable production and valorisation of biomass to both food and non-food will be the framework of operation. Sustainably produced biomass (crops, algae, residues) has to be used as efficiently as possible – using bio-cascading and biorefining approaches – to meet future demands of food, feed, bio-based products (chemicals, materials) and bioenergy (fuels, power, heat).



Biorefineries are already being applied for some considerable time in for example the food industry. Large-scale implementation of biorefineries for Non-food (incl. bioenergy) applications, however, is still lacking. The major reasons for this are that: some of the key technologies (fractionation & product separation), which are part of integrated biorefinery plants, are still not mature enough for commercial market implementation; there is still no level-playing-field for sustainable biomass use for food and non-food applications; market sectors that should co-operate (food, feed, agro, chemistry, energy, fuels, logistics, ...) for the development and commercialisation of fully sustainable biomass value chains, including highly-efficient biorefinery processes, are often still not working together, and there is still a lack of knowledge/expertise on the advantages of biorefinery processes for optimal sustainable biomass use at both industrial, SME and (regional) governmental level.

The aim of the Task is to contribute to the development and implementation of sustainable biorefineries – as part of highly efficient, zero waste value chains – synergistically producing bioenergy and bio-based products as a base for a global bio-economy.

Bioenergy (fuels, power, heat) is expected to play an initiating role in the transition to a bio-economy **in the short-term** by providing biomass mobilization & certification expertise, running facilities & infrastructure and including stakeholders that potentially can be used to kick-start biorefinery deployment. On the **mid and longer-term** bioenergy (fuels, power, heat) is expected to play a central role in the bio-economy by:

- the valorisation of primary (agro), secondary (process) and tertiary (post-consumer) chain residues to both power/heat to be used to meet internal product-driven biorefinery-based process energy requirements or for external use, and to advanced biofuels to meet (part of) the logistical energy requirements for biomass sourcing and product delivery purposes – **product-driven biorefinery approach**;
- the valorisation of non-food crops (terrestrial and aquatic) to advanced biofuels for heavy duty transport, aviation, and shipping (and value-added bio-based products from process residues) – **biofuel-driven biorefinery approach**;
- the valorisation of both biomass residues and non-food crops to power/heat in high-efficient co-firing & conversion facilities, potentially with upstream value-added products extraction and/or valorisation of process residues – **energy-driven biorefinery approach**.

Challenges to be tackled

- Develop industry legitimacy and a level-playing field for sustainable biomass use
- Multi-sectorial stakeholder involvement in the deployment of sustainable value chains
- Technology development and biorefinery scale-up using best practices
- Unlock available expertise and industrial infrastructure energy/fuel, agro/food, material and chemical manufacturing sectors
- Develop the necessary human capital by training students and other stakeholders to become the biorefinery experts of tomorrow

The Task commenced in January 2007.

Participating countries: Australia, Austria, Canada, Denmark, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand and the USA.

Task Leader: Drs Ing René van Ree, Wageningen UR – Food and Bio-based Research, the Netherlands

Assistant Task Leader: Dr Ed de Jong, Avantium Technologies BV, the Netherlands

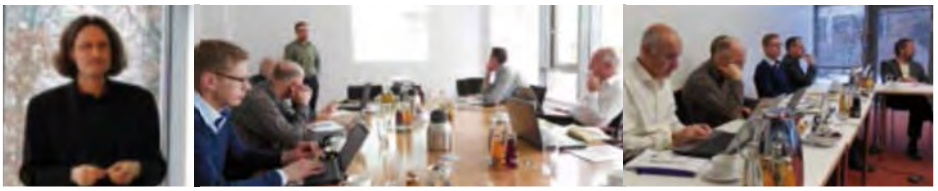
Operating Agent: Ir Kees Kwant, NL Enterprise Agency, Ministry of Economic Affairs, the Netherlands

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task. For further details on Task 42, please refer to Appendices 2, 4, 5 and 6; the Task website www.IEA-Bioenergy.Task42-Biorefineries.com and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings & Workshops

The **15th Task 42 Progress Meeting** took place on 22-23 January 2014 in Berlin, Germany. The meeting was coupled to a half-a-day joint Task 39/Task 42 meeting on biofuel-driven biorefinery approaches with lectures of Borregaard (Task 39) on Perspectives of the Wood Based BR and on the Biorefinery Fact Sheet Methodology (Task 42).



15th Task42 Progress Meeting in Berlin (D)

The **16th Task 42 Progress Meeting** was organised on 27 June 2014 in Hamburg, Germany, downstream of the BC&E-2014 International Conference. It was decided to organise this additional Task 42 Meeting halfway through the triennium with the main goal to monitor the progress of the activities.

The **17th Task 42 Progress Meeting** was organised from 3-5 December 2014 in Guelph & Toronto Airport, Canada, coupled to the Canadian Bio-Economy Conference "Biofuels to Bio-Economy" (1-3 December 2014) @ which Task 42 provided 6 lectures on the International Evolution from Biofuels to Biorefineries.

17th Task42 Progress Meeting in Guelph & Toronto (CAN)

Task42 contributed to the **3rd European Biorefining Training School** that was organised by the European Climate-KIC Initiative in Budapest (Hungary) from 7-10 July 2014 by providing lectures on "Value chain assessment of biofuel-driven biorefineries (Austria)", "Sustainable processing of biomass for food and non-food applications (Netherlands)", and "Biorefinery – the bridge between agriculture and chemistry (Netherlands)".

Task42 organised a **workshop** (introducing lectures & discussion) on "The role of industry in a transition towards the Bio-Economy (BE) in relation to biorefinery" on 3 September 2014 as Satellite Event of the i-SUP2014 Conference in Antwerp (BEL).

For the **next Task 42 Progress Meetings** the following locations and dates have been selected: **18th Progress Meeting: 4-6 May 2015 in Sassari, Sardinia (Italy)**. This meeting will include a joint Task 40/Task 42 workshop on "The future biomass demand in the Bio-based Economy", an Italian (industrial) stakeholder meeting, and an excursion to the Matrica biorefinery facility of Versalis and Novamont. **19th Progress Meeting: 29-30 October 2015 in Berlin (D)** linked to the IEA Bioenergy 2015 End-of-Triennium Conference on 27-28 October 2015 in which Task 42 will fill-up a specific biorefining session with 4 lectures.

All presentations given at the Task meetings can be found on the Task website.

Work Programme

The 2013-2015 work programme of the Task is based on a prioritisation of activities agreed upon by the participating countries, and is as follows:

1. *Assessment of the market deployment potential of integrated biorefineries*
   - Technical and non-technical critical success factors
   - Disruptive/game changing technologies
   - Biorefinery-Complexity-Index (BCI)

2. *Support of industrial/SME stakeholders finding their position in a future bio-economy*
   - Role of involved market sectors in the transition to a bio-economy
   - Upgrading strategies for existing industrial infrastructures
   - Factsheets on major biorefineries/national case studies
   - Updating of bio-chemicals report

3. *Analysis of optimal sustainable biomass valorisation using the market-pull perspective approach*
   - LEEAFF-indicators sustainability assessment
   - Mobilising sustainable bioenergy supply chains
   - Future market demand for biomass from a bio-economy perspective
   - Assessment of national bio-economy strategies

4. *Preparation of advice for policy makers on current status, future potential and priority needs*
   - Biorefinery (related) policies in participating countries
   - Country reporting

5. *Biorefinery knowledge dissemination*
   - Bi-annual task and stakeholder meetings, incl. excursions
   - Annual task meetings at national level
   - Task website (public internet and closed members area)
   - Task newsletters
   - Glossy task brochure, poster, leaflet
   - International workshops and conferences

6. Delivery of biorefinery training activities

- Annual training school on biorefining

The progress achieved is described below.

1. Assessment of the market deployment potential of integrated biorefineries

Concerning the activity on identifying major biorefinery-related technical and non-technical critical success factors a draft slide-deck with the major results was presented by DOE (US) at the Task 42 Progress Meeting in Canada in December 2014. The final slide-deck will be published on the Task 42 website in Q1 2015.

At the Canadian Progress Meeting the Task 42 co-chair (NL) presented a draft slide-deck on major disruptive/game changing technologies effecting biorefinery market deployment. This slide-deck will be finalised in Q1 2015 and published on the website in Q1 2015.

The activity on centralized vs. decentralised processing was defined in the initial work programme by France. France, however, finally decided not to join Task 42, and therefor this activity has been deleted from the programme.

The Biorefinery-Complexity-Index (BCI) activities were finalised already by mid-2013, and a final working document with a description and major results can be found at the Task 42 website.

2. Support of industrial/SME stakeholders finding their position in a future bio-economy

In 2013 a first set-up of the work plans concerning the analysis of a) the role of involved market sectors in the transition to a bio-economy and b) potential upgrading strategies of existing industrial infrastructures to highly-efficient biorefinery facilities has been prepared by respectively the Danish and Austrian Task representatives. A stakeholder workshop on "The role of industry in a transition towards the bio-economy (BE) in relation to biorefinery" was organised on 3 September 2014 as a Satellite Event of the i-SUP2014 Conference in Antwerp (BEL). Two major questions were tackled in the workshop, viz.: 1) What are the changing roles of different industrial stakeholders in the transition to a BE? 2) What are the opportunities for upgrading existing industrial infrastructures to sustainable biorefineries? The results of this workshop, together with the answers to a questionnaire that was sent-out to about 25 industrial stakeholders by the end of 2014 covering the same questions, will be published on the website in Q1 2015.

Considering the potential use of industrial infrastructures to kick-start biorefinery deployment by upgrading these already existing facilities Austria has assessed some specific Austrian examples. In the first half of 2015 examples of other countries potentially will be assessed, and the results will be published on the website in June 2015 at the latest.

Several Biorefinery Factsheets have been developed already and are available at the website. Both Tasks 39 (biofuels) and 34 (pyrolysis), and the country representatives within Task 42, have been asked to provide additional biorefinery facility/concept data-sets, so that more factsheets can be made. Depending on their inputs, additional factsheets will be developed and put on the Task 42 website during 2015.

Two additional Task 42 reports will be published in 2015, viz.:

- Proteins for Food, Feed and Bio-based Applications – Biorefining of Protein Containing Biomass. Expected finalisation & publication 1st half 2015.
- Value Added Products from Biorefineries – Bio-based Chemicals and Polymers (update 2011 report). Expected finalisation & publication 2nd half 2015.

3. Analysis of optimal sustainable biomass valorisation using the market-pull perspective approach

In 2013 & 2014 Canada elaborated the so called LEEAFF-indicators for the sustainability assessment of integrated biorefineries (alternative activity replacing the sustainability assessment toolbox).

This Canadian methodology is now being reported. The final report will be published on the website in the 1st half of 2015.

The strategically funded inter-Task project "Mobilising sustainable bioenergy supply chains" – coordinated by Task43 – was kicked-off at the end of 2012.

This project is organised around 5 case studies, viz.: agricultural residues for bioenergy and biorefineries, mobilising temperate and boreal forest supply chains, integration of lignocellulosic crops into agricultural landscapes, regional biogas production, and cultivating pastures and grasslands. From a Task 42 point-of-view this project should consider both the assessment of conventional reference supply – valorisation chains (bioethanol, biogas, ...) and more advanced and optimised refinery chains in which chain and process residues are valorised to added-value bio-based products to improve overall economics. Task 42 contributes to this project by bringing its specific biorefinery knowledge, and assisting in the sustainability assessments, specifically in case studies 1 and 4; whereas Task 42 potentially will also bring in their factsheet set-up for dissemination of the assessment results of all cases.

In 2013 a joint project on assessing the "Future market demand for biomass from a Bio-Economy perspective" was started. Within this project the potential international supply, trade and demand for biomass for energy and fuel applications within a competing bio-economy market will be assessed, including the identification of improved and new value chains. Task 42 contributes to this project by providing information on: which types of biorefineries are expected to be implemented as a function of time, which feedstocks they will use, and where they will be located. Task 42 will also give input concerning the specification of bio-based commodities and potential biomass trade chains (UCR-NL and COL-NL). Task 40 will provide complementary analysis in which the possible feedstock supply in terms of available quantities, countries of origins, types of supply chains, and feedstock cost levels at the biorefinery gate will be investigated. On 5 May 2015 a workshop will be organised in Sassari, Sardinia (IT) – coupled to the 18th Task 42 Progress Meeting – to implement real market data in the project analysis, to present preliminary results, and to obtain feedback from stakeholders from within the Tasks' participating countries. Overall results will be published in a joint Task 40/42 final report in 2015.

On specific request of the IEA Bioenergy ExCo, Task 42 partners Austria, Italy and The Netherlands made an assessment of National Bio-Economy Strategies in the 22 IEA Bioenergy partnering countries. The Netherlands prepared a slide-deck format, and both Austria (IEA Bioenergy Task 42 countries) and Italy (other IEA Bioenergy countries) made the assessments. As a result of this activity a slide-deck was set-up with national bio-economy strategy data and some overall conclusions, that was presented to all attendees of ExCo74 in Brussels, Belgium in October 2014. This slide-deck will be finalised in Q1 2015 and put on the website of Task 42. Major results will be presented at the European Bioenergy Conference in Vienna in June 2015.

4. Preparation of advice for policy makers on current status, future potential and priority needs

In contrast to what was expected earlier, IEA Headquarters is not setting-up a Project (Roadmap) on Sustainable Biomass Valorisation by the Biorefining Approach. Therefore, Task 42 will not participate in such an initiative, and therefore this activity has been deleted from the 2013-2015 work programme.

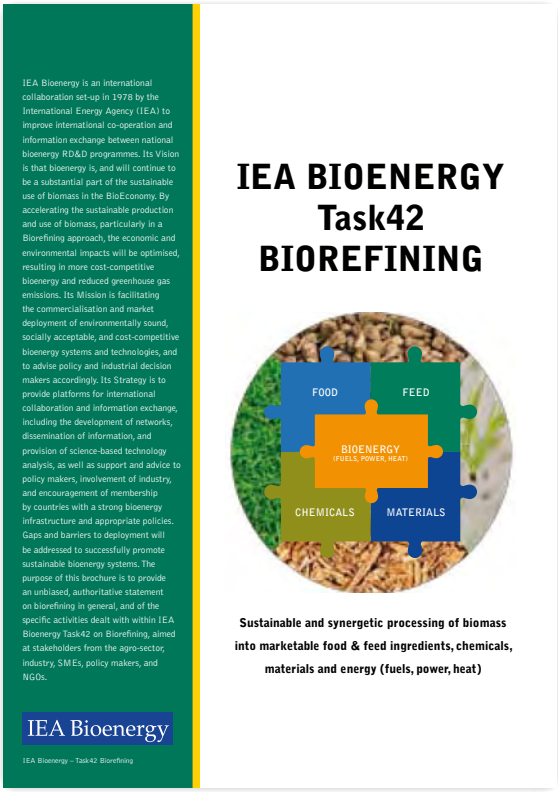
In 2013 a Power-point format for country reporting concerning the status and developments of biorefineries and biorefinery-related policy issues was prepared by the Netherlands. These country reports include information on: country specific energy consumption, biomass use for energy and non-energetic applications, economic added-value BBE, biomass related (national) policy goals & instruments, bio(based) economy strategy, biomass related sustainability aspects, commercial biorefineries, biorefinery demonstration and pilot plants, major R&D projects, regional initiatives, and major national stakeholders involved in the field of biorefining. By the end of 2014, country reports are available on the Task 42 website for the following countries: Austria, Canada, Denmark, Germany, Italy, Japan, The Netherlands, New Zealand, and the USA. The reports from Australia and Ireland are still lacking for the moment, but are expected to be delivered in 2015.

5. Biorefinery knowledge dissemination

Concerning Task 42 Progress Meetings, incl. industrial stakeholder meetings and excursions & international workshops and conferences see paragraph on Task Meetings & Workshops above; contributions to international workshops and conferences can be found at the Task 42 Publications section.

No Task 42 newsletters were produced so far. In Canada (December 2014) it was decided to produce a newsletter following a (bi-annual) Task 42 Progress Meetings. The newsletter will contain biorefinery news from partnering countries (presented at the roundtable Task Progress meeting), such as: new commercial/demonstration/pilot plants, new projects, new regional initiatives, policy issues, new publications, and biorefinery related events from the international calendar. The Netherlands will prepare the newsletter and will transfer it to the national country representatives for dissemination within their respective countries.

In August 2014 a major Task 42 report was delivered, viz.: IEA Bioenergy Task42 Biorefining – Sustainable and synergetic processing of biomass into marketable food & feed ingredients, chemicals, materials and energy (fuels, power, heat). Two thousand five hundred hardcopies of this report have been disseminated at a variety of national and international biorefinery and bioenergy events. The report is available at the Task 42 website for download.



6. Delivery of biorefinery training activities

Task 42 contributed to the 3rd European Biorefining Training School that was organised by the European Climate-KIC Initiative in Budapest (Hungary) from 7-10 July 2014 by providing 3 lectures on "Value chain assessment of biofuel-driven biorefineries (Austria)", "Sustainable processing of biomass for food and non-food applications (The Netherlands)", and "Biorefinery – the bridge between agriculture and chemistry (The Netherlands)".

Task Website

The Task 42 website – www.IEA-Bioenergy.Task42-Biorefineries.com – was successfully upgraded during 2014. All Task 42 deliverables and major biorefinery information in general can be found at this website. For the time being no website statistic were available, however, these will be reported at the next ExCo in Dublin in May 2015.

Collaboration with Other Tasks/Networking

In 2014 co-operation was established with international activities, such as: other Tasks (Task 39 and 34 on Biorefinery Factsheet Data, Task 40 on biomass supply for the bio-economy, and Task 43 et al. within the multi-tasks strategic project on sustainable bioenergy chains), European-based Technology Platforms (o.a. EBTP), EC Specific Support Actions, and EC FP7 Integrated Projects. This co-operation will be enhanced in 2015 by organising joint events, e.g. workshops and meeting.

Deliverables

Deliverables in 2014 included: Report IEA Bioenergy Task42 Biorefining – Sustainable and synergetic processing of biomass into marketable food & feed ingredients, chemicals, materials and energy; County Reports for Austria, Canada, Denmark, Germany, Italy, Japan, The Netherlands, New Zealand, and the USA; draft slide-decks on non-technical critical success factors and disruptive/game changing technologies, 5-10 Biorefinery Fact Sheets; organising and reporting of three Task Progress Meetings coupled to a related international conferences in Hamburg (Germany) and Toronto (Canada); reporting to the ExCo (two progress reports, audited accounts 2013, a contribution to the Annual Report 2013, a first draft set-up of the Task 42 Work Programme 2016-2018); set-up and management of a new Task website.

TASK 43: Biomass Feedstocks for Energy Markets

Overview of the Task

Work in the current triennium is based on the premise that in many countries biomass demand for energy will enter a period of expansion as a way to ensure sustainable and secure energy sources. Organic consumer waste as well as biomass from many land uses (e.g. forestry residues, straw, dedicated energy crops) can become a plausible energy source if production systems are economically and environmentally attractive. Science, governance and technology must support this expansion ensuring that suitable production systems are established and can be relied on to help achieve the climate and energy policy targets in many countries.

The objective of the Task is to promote sound bioenergy development that is driven by well-informed decisions in business, governments, and elsewhere. This will be achieved by providing relevant actors with timely and topical analyses, syntheses, and conclusions on all matters relating to biomass feedstock, including biomass markets and the socio-economic and environmental consequences of feedstock production.

The work programme has a global scope and includes commercial, near-commercial and promising production systems in agriculture and forestry. The primary focus is on land use and bioenergy feedstock production systems. The Task will be concerned with issues related to the linking of sustainable biomass feedstocks to energy markets, explicitly considering environmental and socio-economic aspects.

Participating countries (Dec 2014): Australia, Canada, Croatia, Denmark, European Commission, Finland, Germany, Ireland, the Netherlands, Norway, Sweden, United Kingdom, and the USA

Task Leader: Associate Professor Göran Berndes, Chalmers University of Technology, Sweden

Associate Task Leaders: Professor Tat Smith, University of Toronto, Canada and Dr. Bill White, Kingsmere Economic Consulting, Edmonton, Canada

Task Secretary: Assistant Professor Sally Krigstin, University of Toronto, Canada

Operating Agent: Dr Åsa Forsum, Swedish Energy Agency, Sweden

The Task Leader directs and manages the work programme assisted by an international team. A National Team Leader (NTL) from each country is responsible for coordinating the national participation in the Task. The Task capacity is further increased through the NTLs engaging support persons within their country and through establishing cooperation with other organizations in specific areas.

For further details on Task 43, please refer to Appendices 2, 4, 5 and 6; the Task website www.ieabioenergytask43.org and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and workshops

A number of business/planning meetings were held in 2014: (i) Uppsala, Sweden, January 21-22: Task 43 planning meeting (ii) Copenhagen, Denmark, May 21-23: Task 43 business meeting and planning meetings in inter-task project "Mobilizing sustainable bioenergy supply chains"; (iii) Bussels, Belgium, October 23-24: Task 43 business meeting and planning meeting.

The Task has organized four international workshops/conference sessions in 2014: (i) *Bioenergy and water: Developing strategic priorities for sustainable outcomes*, joint workshop with UNEP, IINAS and Winrock International, Paris, France, Feb 21-22; (ii) *Forests, bioenergy and climate change mitigation*, joint workshop with Task 38, Task 40, IINAS, EEA, JRC, Copenhagen, Denmark, May 19-20; (iii) *Use of agricultural residues for energy*, joint workshop with JRC, the Scientific Engineering Centre "Biomass", and the Bioenergy Association of Ukraine; (iv) *Forest Biomass Supply Chains: Practice, Economics, and Carbon Balance*, conference session organized by Swedish Task 43 NTL Gustaf Egnell at 24th IUFRO World Congress – Sustaining forests, sustaining people. The role of research. Oct 5-11, 2014, Salt Lake City, Utah, USA.

Through Task Leader Berndes, the Task also contributed to the ExCo74 workshop *Bioenergy: Land use and mitigating iLUC*, Brussels, Belgium, Oct 23.

Work Programme

The Task engages in a number of activities that concern aspects that are central to sustainable bioenergy feedstock production and supply, noting the need to go beyond environmental sustainability and socioeconomic analysis and address a wider set of questions that are critical to mobilising sustainable bioenergy supply chains globally. The technical view on biomass production systems and supply chains is complemented with a perspective of producers and the obstacles they face in changing from conventional production systems or integrating energy into conventional production systems. This adds an integrated view on feedstock production and energy markets including policies and other factors that can shape market development and economic opportunities.

As outlined in the 2013-2015 work programme, the Task identified three thematic areas for its work:

Land use and sustainable bioenergy feedstock supply systems, where the Task takes a landscape perspective to exploring options for expanding bioenergy feedstock production in agriculture and forestry. Specifically, the Task addresses the question of how bioenergy feedstock production systems can be located, designed and managed so as to optimise the contribution to sustainability objectives at a local, regional and global scale. The Task pays special attention to the producer perspective and the factors that influence the operating conditions for biomass producers. A key question raised is: *what are the necessary and sufficient conditions for financial investment in developing attractive biomass production systems*?

One important deliverable in this area during 2014 was the report *Consequences of an Increased Extraction of Forest Biofuel in Sweden* (Task 43 report TR2014:01) that provides a summary and synthesis of the state of scientific knowledge concerning environmental effects of biomass extraction in forests managed with long rotations. Another highlight was the 2-day workshop *Bioenergy and Water: Developing strategic priorities for sustainable outcomes* and the subsequent work to establish a new Activity Group on bioenergy and water within GBEP, which was approved by the GBEP steering committee in November (www.globalbioenergy.org/programmeofwork/working-group-on-capacity-building-for-sustainable-bioenergy/activity-group-6/en/).

Assessment and certification of sustainability, where Task 43 works with other Tasks and also other organizations active in the area of certification. The Task provides expert advice concerning criteria and indicators for sustainable biomass production and collects and synthesises technical information on biomass supply systems and their performance in relation to sustainability criteria. The Task also engages in the development and evaluation of methods and tools for sustainability assessment of bioenergy feedstock supply systems. One highlight in this area during 2014 was the finalization of the report *Assessing the Environmental Performance of Biomass Supply Chains*, with contributions from 14 authors under the leadership of Jörg Schweinle, Task 43 NTL for Germany (Task 43 report TR2015:01).

Several Task NTLs and associates have roles (e.g., national experts, advisors, board members) in relation to the development of legal regulations, certification systems and standards. In these capacities they can link the work in the Task with important processes in the area of sustainability certification.

Socio-economic drivers in implementing sustainable bioenergy production and supply, includes investigations of (i) options for improving and enhancing the use of biomass by poorer groups of society facing fuel poverty; and (ii) ways of financing bioenergy projects using innovative financial instruments. The work under (i) includes both addressing barriers to bioenergy use, and promotion of best practices for using bioenergy, often in hybrid or multi-technology solutions including other renewables and embracing novel business model solutions (such as co-operatives or social enterprises). The work under (ii) highlights the importance of investment and regional cooperation to promote biomass utilisation. The Task also contributes to the development of energy service company models for bioenergy. An important part of the work in this area takes place within the Inter-Task project "Mobilizing sustainable bioenergy supply chains", which is coordinated by Task 43.

Systematic knowledge transfer is achieved through the website, reports and briefs, international collaboration, and IEA networks to educate and inform the bioenergy sector. The Task is engaged via editorship in two scientific journals: (i) *WIREs: Energy and Environment* (Associate Editor for the bioenergy area); (ii) *Biofuels, Bioproducts and Biorefining* (Consultant Editor). These and other journals offer valuable opportunities for outreach via special issue publications, occasional articles and editorials.

Website

The Task website (www.ieabioenergytask43.org) was re-designed and launched in October 2013, with the objective of obtaining a wider Task exposure. The website gives information about Task 43 and presents the outcomes of Task activities. It also provides web-based archives to the previous Tasks 29, 30 and 31, as well as a link to the Forest Energy Portal (see: www.forestenergy.org) and the web based dissemination tool – *Perennial Biomass Crops on the Map* (see: http://www.pbconthemap.org). The Task 43 website contains a members only section which allows for ease of access and quick review of task projects.

Collaboration with Other Tasks/Networking

Task 43 collaborated with Task 38 and Task 40 in the organization of the workshop *Forests, bioenergy and climate change mitigation*. Task 43 further collaborates with several other Tasks in the inter-Task project – *Mobilizing Sustainable Bioenergy Supply Chains* – which runs during the period 2013-2015 and is coordinated by Task 43.

The events and collaborations presented above have involved interactions with several international organizations outside IEA Bioenergy, including GBEP, UNEP, IINAS, JRC, EEA, and Winrock Institute. Task 43 also collaborated with other organizations, including: (i) The Stockholm International Water Institute (SIWI), a policy institute that generates knowledge and informs decision-making towards water wise policy and sustainable development; and (ii) The Canadian Institute of Forestry/Institut forestier du Canada (CIF/IFC), which has a long history of supporting and delivering timely, relevant and successful forest science, and fostering professional and public awareness. CIF/IFC has assumed responsibility for coordinating Canada's involvement in IEA's Bioenergy Task 43 for 2013–2015. With the support of several project partners and sponsors – including financial support from Ontario Power Generation, the British Columbia Ministry of Forests, Lands and Natural Resource Operations (Competitiveness and Innovation Branch), and the Canadian Council of Forest Ministers (Forest in Mind Program) – CIF/IFC will also cover Task 43 fees that allow Canada to continue to be significantly involved in this program.

Deliverables

Deliverables for 2014 included: (i) Technical and more popular reports (see section "Library" on the Task 43 website); (ii) publications in scientific journals; (iii) conference presentations; and (iv) reporting to the ExCo (progress reports to Exco 73 and ExCo74). Also the organisation and minuting of Task meetings, and updating of the Task website. Please see Appendix 4.

TASK PARTICIPATION IN 2014

TASK	AUS	AUT	BEL	BRA	CAN	CRO	DEN	FIN	FRA	GER	IRE	ITL	JAP	KOR	NEL	NZE	NOR	SA	SWE	SWI	UK	USA	EC	Total
32		•	•				•			•	•		•		⊗		•	•	•	•	•			12
33		⊗					•	•		•		•			•		•		•	•		•		10
34								•		•					•				•		•	⊗		6
36									•	•		•					•		•		⊗			6
37		•		•			•	•	•	•	•			•	•		•		•	•	•		⊗	14
38	⊗			•				•	•	•							•		•			•		8
39	•	•		•	⊗		•			•		•	•	•	•	•	•	•	•			•		15
40		•	•	•			•	•		•		•			⊗		•		•		•	•		12
42	•	•			•		•			•	•	•	•		⊗	•						•		11
43	•				•	•	•	•		•	•				•		•		⊗		•	•	•	13
Total	4	6	2	4	3	1	7	6	3	10	4	5	3	2	8	2	8	2	9	3	6	7	2	107

⊗ = Operating Agents • = Participant

Note: In addition to the above the following Task was completed in 2014: Task 41, Project 4 (participants are the EC and Norway). This was a joint projects with the AMF Implementing Agreement.

BUDGET IN 2014 – SUMMARY TABLES

Budget for 2014 by Member Country (US$)

Contracting Party	ExCo funds	Task funds	Total
Australia	10,700	63,500	74,200
Austria	12,700	93,000	105,700
Belgium	8,700	32,500	41,200
Brazil	10,700	61,500	72,200
Canada	9,700	47,500	57,200
Croatia	7,700	15,000	22,700
Denmark	13,700	108,000	121,200
Finland	12,700	96,500	109,200
France	9,700	44,320	54,020
Germany	16,700	159,320	176,020
Ireland	10,700	60,500	71,200
Italy	11,700	80,320	92,020
Japan	9,700	47,500	57,200
Korea	8,700	28,000	36,700
Netherlands	14,700	128,000	142,700
New Zealand	8,700	32,500	41,200
Norway	14,700	121,820	136,520
South Africa	8,700	30,000	38,700
Sweden	15,700	141,820	157,520
Switzerland	9,700	43,000	52,700
UK	12,700	98,820	108,520
USA	13,700	116,000	129,700
European Commission	8,700	28,000	36,700
Total	**261,100**	**1,674,420**	**1,935,520**

BUDGET IN 2014 – SUMMARY TABLES

Budget for 2014 by Task (US$)

Task	Number of participants	Annual contribution per participant	Total Task funds
Task 32: Biomass Combustion and Co-firing	12	15,000	180,000
Task 33: Thermal Gasification of Biomass	10	15,000	150,000
Task 34: Pyrolysis of Biomass	6	20,000	120,000
Task 36: Integrating Energy Recovery into Solid Waste Management	6	15,320	91,920
Task 37: Energy from Biogas	14	13,000	182,000
Task 38: Climate Change Effects of Biomass and Bioenergy Systems	8	16,000	128,000
Task 39: Commercialising Liquid Biofuels from Biomass	15	15,000	225,000
Task 40: Sustainable International Bioenergy Trade – Securing Supply and Demand	12	17,500	210,000
Task 41: Bioenergy Systems Analysis	3	0	0
Task 42: Biorefining: Sustainable Processing of Biomass into a Spectrum of Marketable Bio-based Products and Bioenergy	11	17,500	192,500
Task 43: Biomass Feedstocks for Energy Markets	13	15,000	195,000
Total			**1,674,420**

CONTRACTING PARTIES

Bioenergy Australia (Forum) Ltd

The Republic of Austria

The Government of Belgium

The National Department of Energy Development of the Ministry of Mines and Energy (Brazil)

Natural Resources Canada

The Energy Institute "Hrvoje Pozar" (Croatia)

The Ministry of Transport and Energy, Danish Energy Authority

Commission of the European Union

Tekes, Finnish Funding Agency for Technology and Innovation

L'Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME) (France)

Federal Ministry of Food and Agriculture (Germany)

The Sustainable Energy Authority of Ireland (SEAI)

Gestore dei Servizi Energetici – GSE (Italy)

The New Energy and Industrial Technology Development Organization (NEDO) (Japan)

Ministry of Knowledge Economy, the Republic of Korea

NL Enterprise Agency (The Netherlands)

The New Zealand Forest Research Institute Limited

The Research Council of Norway

South African National Energy Development Institute (SANEDI)

Swedish Energy Agency

Swiss Federal Office of Energy

Department of Energy and Climate Change (United Kingdom)

The United States Department of Energy

LIST OF REPORTS AND PUBLICATIONS

The Executive Committee

Final Minutes of the ExCo73 meeting, Copenhagen, Denmark, May 2014.

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Karatzos, S.: The potential and challenges of 'drop-in' fuels

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Højer, J.: Wood to green gasoline using Carbona gasification and Topsoe TIGAS processes

van der Werf, W.: Advanced fuels and chemicals from waste: waste in a circular economy

Ferrero, S.: 2G biofuels from biomass going commercial

May, O.: DSM Bioenergy solutions: from rocket science to bright science for biofuels

Nylund, N-O.: Transport technology options

Haraldson, L.: Heavy duty engines

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Nuottimäki, J.: Light duty vehicles

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Peters, D.: Low indirect impact biofuel methodology

Berndes, G.: Integrating crops into agricultural landscape

Wicke, B.: iLUC mitigation illustrated for regional case studies

Nassar, A.: Pasture intensification and double cropping as mechanisms to mitigate iLUC

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Maniatis, D.: REDD+

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TASK 32

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Minutes of the Task meeting in Johannesburg and Sabie, South Africa, Nov 2014

IEA Bioenergy Task 32 Newsletter, Issue 9, June, 2014.

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Thomas Nussbaumer, Stefan Thalmann, Status Report on District Heating Systems in IEA Countries, IEA Bioenergy Task 32, Swiss Federal Office of Energy, and Verenum, Zürich 2014, ISBN 3-908705-28-2

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Mark Beekes, KEMA Nederland BV, Arnhem, Netherlands, Advantages and drawbacks for international trade of torrefied products

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Lars-Gunnar Johansson, Chalmers, Sweden, keynote lecture on HT Corrosion

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Hans Bengtsson, AZZ Welding Services, Sweden, Overlay welding

Melanie Montgomery, COWI, Denmark, Experiences with high temperature corrosion at straw-firing power plants in Denmark

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Yokesh Singh, Eskom, South Africa, Overview of Biomass Related Activities at Eskom

Jaap Koppejan, Procede Biomass BV, Netherlands, Torrefaction Mark Beekes, DNV-GL, Netherlands, Biomass Cofiring and Full Conversion

Ingwald Obernberger, Graz University of Technology, Austria, Industrial Biomass Combustion – reached developments and future outlook

Michael Temmerman, CRA Gembloux, Belgium, Rural Energy: Improved Charcoal Production and Woodstoves

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www.ieabioenergytask32.com

TASK 33

Report from the workshop 'Thermal Biomass Gasification in Small Scale' 14 May 2014

Marco Fantacci, General Manager, BIO&WATT Gasification s.r.l., Energetical Conversion of Biomass Through Pyrogasification Process: Presentation of an Industrial Solution

Andrea Duvia, Gammel Duvia Engineering s.r.l., Industrial Experiences and Innovative Solutions

Marcel Huber, Syncraft, Austria, The Floating-Fixed-Bed – Status of a Unique Staged Gasification Concept on its Way to Commercialization

Giovanna Ruoppolo, CNR – National Research Council, Fluidized Bed Gasification and Co-Gasification of Biomass and Wastes

Paola Ammendola, CNR – National Research Council, Development of Catalytic Systems for Tar Removal in Gasification Processes

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Simeone Chianese, University Of Naples and TUV Of Vienna, H24 Industries

Simeone Chianese and Nadia Cerone, ENEA, Gasification of Fermentation Residues From Second Generation Ethanol for Production of Hydrogen Rich Syngas in a Pilot Plant

Report from the workshop 'Liquid Biofuels', 04 November 2014

Manfred Wörgetter, bioenergy 2020+, Austria, Introduction to IEA Task 39: Commercializing Liquid Biofuels

Thomas Wurzel, Air Liquide Global E&C, Germany, 2nd Generation Biofuels – The Bioliq Technology and Economic Perspectives

Rikard Gebart, Luleå University of Technology, Sweden, Conversion of Forest Industry By-Products to Methanol and DME

Sven Petersen, Linde Engineering Dresden GmbH, Germany, Carbo-V – Biomass Gasification Technology

Malin Hedenskog, Göteborg Energi, Sweden, GoBioGas Project – Experiences and Operational Progress

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Peter Pfeiffer, KIT – Institut für Mikroverfahrenstechnik (IMVT), Germany, Technology for Fischer-Tropsch Synthesis of Liquid Fuel in Small Scale

Please also visit the Task website: www.ieaTask33.org

TASK 34

Minutes of the Task meeting in Solihull, UK, May 2014.

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J Vehlow	The Upswing process: the combination of an incinerator and a power plant
K Riley	Drivers for advanced thermal technologies – gasification in Europe
N Patel	Defra policy update and the impacts of incentives on EfW development in the UK
A Read	Sustainable Cities

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The publications are available from Pat Howes, please email: pat.howes@ricardo-aea.co.uk

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Jerry Murphy, University College Cork, Task 37 Ireland – Gaseous algal biofuels

Mathieu Dumont, RvO, Task 37 Netherlands – Green gas grids

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TASK 40

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- **Michael Wild, Wild and partners.** Torrefaction–International Overview of Developments in this Novel Technology

Workshop Biomass trade & supply system opportunities in a world-wide bio-based economy, Jonkoping, Sweden – 4 Jun 2014:

- **Anders Evald, HOFOR.** One million tonnes of wood: considerations on feedstock price versus quality issues and supply options for a large scale biomass project
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- **Patrick Lamers, INL.** Biomass trade and supply system opportunities for a worldwide bio-based economy

International workshop: Towards sustainable international biomass trade strategies, Brussels – 24 October 2014:

- **Uwe R. Fritsche, Leire Iriarte, IINAS.** Assessing sustainable biomass export potentials: methodological considerations
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- **Martin Junginger, UU.** Biomass trade for energy: history & future expectations
- **Thuy Mai-Moulin & Martin Junginger, UU.** Sustainable Lignocellulosic Biomass Potentials in Mozambique and Kenya – preliminary results.
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TASK 41

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TASK 42

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9 Biorefining Country Reports (AT, CAN, DEN, D, IT, JAP, NL, NZ and the US)

Draft slide-deck on National BioEconomy Strategies IEA Bioenergy partnering countries, finalisation Q1 2015, paper presentation @ Bioenergy Conference 2015, Vienna, June 2015

Draft slide-deck on non-technical critical success factors biorefinery deployment, finalisation Q1 2015

Draft slide-deck disruptive/game changing technologies, finalisation Q1 2015

8 Biorefinery Fact Sheets

Draft Report Proteins for Food, Feed and Bio-based Applications, to be published 1st half 2015

Minutes of the 15h Task Progress Meeting, Berlin, Germany, 22-23 January 2014

Minutes of the 16h Task Progress Meeting, Hamburg, Germany, 27 June 2014

Minutes of the 17h Task Progress Meeting, Guelph/Toronto, Canada, 3-5 December 2014

Progress report for ExCo73, Copenhagen, Denmark, May 2014

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Progress report for ExCo74, Brussels, Belgium, October 2014.

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KEY PARTICIPANTS IN EACH TASK

TASK 32 – Biomass Combustion and Co-firing

Operating Agent: Kees Kwant, NL Enterprise Agency, the Netherlands.
For contacts see Appendix 7.

Task Leader: Jaap Koppejan, Procede Biomass BV, the Netherlands.
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Denmark	Anders Evald	Force Technology
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Ireland	John Finnan	Teagasc
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	Robert van Kessel	DNV KEMA
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South Africa	Yokesh Singh	ESKOM
Sweden	Claes Tullin	Swedish National Testing and Research Institute
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TASK 33 – Thermal Gasification of Biomass

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For contacts see Appendix 6.

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Finland	Ilkka Hannula	VTT Energy
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The Netherlands	Bram van der Drift	ECN

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Switzerland	Martin Rüegsegger	ETECA
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Germany	Dietrich Meier	Thünen Institute for Wood Research
Netherlands	Bert van de Beld	BTG (Biomass Technology Group)
Sweden	Magnus Marklund	ETC (Energy Technology Centre)
United Kingdom	Anthony Bridgwater	Aston University
USA	Douglas Elliott	PNNL (Pacific Northwest National Laboratory)

TASK 36 – Integrating Energy Recovery into Solid Waste Management

Operating Agent: Elizabeth McDonnell, Department of Energy and Climate Change (DECC), UK.
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TASK 37 – Energy from Biogas

Operating Agent: Kyriakos Maniatis, European Commission, Belgium.
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Task Leader: David Baxter, EC JRC Petten, the Netherlands.
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TASK 38 – Climate Change Effects of Biomass and Bioenergy Systems

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France	Roland Gerard	Ademe Service Bioresources
Germany	Sebastian Rüter	Thünen Institute of Wood Research
Norway	Anders Strømman	Norwegian University of Science and Technology

Sweden	Leif Gustavsson	Linnaeus University
	Matti Parikka	Swedish Energy Agency
USA	Alison Goss Eng	US Department of Energy
	Helena Chum	National Renewable Energy Laboratory

TASK 39 – Commercialising Liquid Biofuels from Biomass

Operating Agent: Ed Hogan, Natural Resources Canada, Canada.

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Associate Task Leader: Jack Saddler, University of British Columbia, Canada.

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	Dina Bacovsky	Bioenergy 2020+
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	Warren Mabee	Queens University
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	Berta Guell	SINTEF
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	Kyu Young Kang	Dongguk University
	Seonghan Park	Pusan National University

Sweden	Alice Kempe	Swedish Energy Agency
	Maria Nyquist	Swedish Energy Agency
	Jonas Lindmark	Swedish Energy Agency
	Leif Jonsson	Umea University
USA	Jim McMillan	NREL

TASK 40 – Sustainable International Bioenergy Trade: Securing Supply and Demand

Operating Agent: Kees Kwant, NL Enterprise Agency, the Netherlands.

Task Leader (Scientific): Martin Junginger, Copernicus Institute, Utrecht University, the Netherlands.

Task Leader (Industry): Peter-Paul Schouwenberg, RWE, the Netherlands.

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Denmark	Jørgen Hinge	Danish Technological Institute
	Jonas Dahl	
Finland	Tapio Ranta	Lappeenranta Technical University
	Jussi Heinimö	Miktech
Germany	Uwe Fritsche	IINAS
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Norway	Erik Tromborg	Norwegian University of Life Sciences
Sweden	Bo Hektor	Svebio
	Lena Dahlman	Sveaskog
UK	Rocio Diaz-Chavez	Imperial College
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TASK 41 – Bioenergy Systems Analysis

Project 4:	Joint Project with AMF: Biomethane in Heavy Duty Engines
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TASK 42 – Biorefining: sustainable processing of biomass into a spectrum of marketable bio-based products and bioenergy

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Italy	Isabella de Bari	ENEA C.R. TRISAIA
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	Ed de Jong	Avantium B.V.
	Bert Annevelink	Wageningen UR – Food and Biobased Research
New Zealand	Kirk Torr	Scion
United States of America	Steven Thomas	U.S. Department of Energy

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TASK 43 – Biomass Feedstocks for Energy Markets

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