IEA Bioenergy

Task 30 - Short Rotation Crops for Bioenergy Systems
Task 31 - Biomass Production for Energy from Sustainable Forestry

FINAL TECHNICAL PROGRAM

International Workshop

"Multiple Benefits from Sustainable Bioenergy Systems"

Perth, Western Australia
July 31 - August 5, 2005

including

Field Study Tour August 1-2

Hosted by:

IEA Bioenergy Task 30 Short Rotation Crops for Bioenergy Systems
IEA Bioenergy Task 31 Biomass Production for Energy from Sustainable Forestry
Forest Products Commission and Conservation and Land Management,
The Western Australian Government
Bioenergy Australia

Technical program coordination:

IEA Bioenergy Task 31 Biomass Production for Energy from Sustainable Forestry
- Jim Richardson, Task Leader

Venue and field tour coordination:

Mike Buckton, Richard Harper and Stephanie Hutson, Forest Products Commission
Danielle Ottey, Office of Energy, John Bartle, Conservation and Land Management
John Raison, CSIRO and Task 31 National team Leader
Brendan George, NSW Department of Primary Industries and Task 30 National Team Leader

BACKGROUND

This is an international workshop organized jointly by IEA Bioenergy Tasks 30 and 31 in association with agencies of the Western Australian Government and Bioenergy Australia. IEA Bioenergy is an international collaborative R&D agreement, with the aim to accelerate the use of environmentally sound and cost-competitive bioenergy on a sustainable basis, to provide increased security of supply and a substantial contribution to future energy demands. Within this framework, a number of tasks concentrate on different aspects of the bioenergy chain.

The objective of Task 30 is to meet the needs of bioenergy industries through technical improvement of biomass crop production technologies, through documenting and disseminating information on the potential environmental benefits of biomass crop production systems, and through developing information to enhance market development in collaboration with the private sector. The overall aim is to further develop the existing short-rotation biomass production systems, improve the awareness of the bioenergy production potential of the concept and promote the use of biomass for energy in participating countries.

The objective of Task 31 is to develop an integrative framework for information related to biomass production for energy from sustainable forestry, based on leading-edge science and technology; and to share and promote the use of such an information framework with advanced information technology and a high-level of collaboration. The Task has a significant role in identifying research needs and opportunities, assimilating and synthesizing scientific and technical information, and identifying breakthrough technologies in relation to silviculture, forest management, harvesting and transportation in conventional forestry systems.

WORKSHOP OBJECTIVES

This workshop will further the Tasks' work of collecting, synthesizing and sharing leading-edge science and technology on sustainable production of biomass for energy from naturally regenerated forests and plantations that integrate forest management, environmental conditions and socio-economic factors. It will provide an opportunity and venue for resource managers, power industry representatives, bioenergy systems equipment manufacturers, energy production professionals, energy users, program managers, educators, scientists and researchers to exchange information and discuss sustainable management, production and use of forest biomass for energy as an integral part of resource management for multiple benefits. The workshop will focus particularly on practical solutions to lower barriers to implementation of bioenergy systems.

Within that broad general framework, more specific consideration will be given in presented papers and posters and field study visits to issues of:

- bioenergy and changing natural resource management
- establishing and managing forest energy systems for specific environmental benefits
- reducing environmental impacts from forest energy production systems
- effects of intensive forest energy use on site productivity
- efficiency and economics of forest energy operations
- social issues and community development
- certification of sustainable forest energy systems
- policy barriers and constraints and how to overcome them.

WESTERN AUSTRALIA

Western Australia has an environmental challenge to overcome. Salinity, a result of the removal of natural vegetation and replacement by low annual water use crops and pastures, has resulted in rising water tables carrying salt. In south-western Australia it is estimated that up to 7 million ha of land will be affected by salinity by 2050, all inland water supplies will be salinized and up to 450 species are at risk of extinction. Along with a significant loss of farmland productivity there is also a significant threat to infrastructure. Woody crops can play a role in mitigating salinity problems. In the higher rainfall areas of Western Australia (>600 mm MAR) 250,000 ha of eucalypts (*E. globulus*) have been planted in 10 year short-fibre forestry rotations on farmland. This adds to an existing pine plantation resource (*Pinus radiata, P. pinaster*) of 100,000 ha. In drier areas, 20,000 ha of eucalypt mallees and 20,000 ha of *Pinus pinaster* have been integrated into farms to provide a range of products including eucalypt oil, wood and environmental protection. All species have some potential for bioenergy production.

An integrated eucalypt mallee processing plant is at Narrogin, currently being commissioned, has a feedstock requirement of 20,000 tonnes/yr of biomass, producing an expected 7.5 GWh/yr electricity, 690 tonnes/yr of activated charcoal and 210 tonnes/yr of eucalyptus oil. The challenges and developments in such an integrated bioenergy system provide an exciting opportunity for the international bioenergy community to observe the issues in such a bioenergy system providing multiple benefits.

OVERVIEW OF THE WORKSHOP FORMAT

The workshop will commence with a two day field tour, followed by two and half days of technical sessions. Technical sessions will include invited papers along with volunteer posters and papers. The final day will comprise an ‘Industry Day’ featuring exchanges between international experts and regional managers and project developers. The field study tour will visit the agricultural areas inland from Perth the State Capital. This will include visits to plantations of *Pinus radiata* and *P. pinaster* where harvest waste will be used to produce biomass, the Narrogin bioenergy plant and examples of potential bioenergy feedstocks such as phase farming with young tree and coppiced oil mallee plantings. Environmental issues, technology issues such as harvesting, and feedstock management will also be included in the tour. This international workshop will offer attendees the opportunity to make and maintain professional contacts and to identify the opportunities for future collaboration.

The workshop is planned for the week immediately preceding the World Congress of the International Union of Forest Research Organizations (IUFRO) which will take place in Brisbane, Australia August 8-12 (http://www.iufro2005.com/).

PROGRAMME

ARRIVAL IN WESTERN AUSTRALIA — ***Sunday 31 July, 2005***

Participants should arrive at The Vines Resort & Country Club, Swan Valley, Western Australia (www.vines.com.au/index.html) by Sunday evening. The Swan Valley is about 30 minutes from the Perth International and Domestic Airports. Participants can use taxis to reach the venue.

On Sunday evening there will be an informal introductory presentation on forestry in Western Australia by Dr Paul Biggs, CEO of the Forest Products Commission (FPC) of Western Australia.

FIELD STUDY TOUR – DAY 1 – 0800 - 1800 — ***Monday 1 August, 2005***

The field study tour consists of three stops.

Stop 1 at Gnangara, *Pinus pinaster* plantation residues for bioenergy. A 35-40 MW bioenergy plant will be commissioned in 2006 (Mr Mike Buckton, FPC; Mr Cliff Jones, Beacons).
From Gnangara the tour continues to Corrigin via Yealearing and badly salt-affected landscapes. Corrigin is approximately 240 km from Perth. There will be talks on the bus about the agricultural landscape, growing environment for biomass and farming systems.
Stop 2 at a mallee belt planting (Mr John Bartle, CALM). Strips of mallee eucalypts are being grown as feedstock for bioenergy, whilst also aiming to bring the landscape back into hydrological balance. Approximately 20,000 ha of mallee belts have been established in Western Australia.
Stop 3 at Corrigin **-** Phase farming with trees as a broad landscape treatment. Joint Venture Agroforestry Program funded experimentation with short rotation (3-4 year) eucalypts and pines as an alternative, complete landscape treatment to restore landscape hydrology (Dr Richard Harper, FPC). After treatment and the creation of a large, dry soil buffer against future leakage, the trees could be used for biomass.

Participants will stay overnight in the Albert Facey Motel in Narrogin (Albert Facey was a local pioneer and the author of an Australian classic, *A Fortunate Life*).

FIELD STUDY TOUR – DAY 2 – 0800 - 1800 — ***Tuesday 2 August, 2005***

Stop 4 at Narrogin. The field study tour continues with a stop at the Narrogin mallee processing/bioenergy plant (Western Power/CALM).
Stop 5 near Collie. On route to Collie a *Eucalyptus globulus* plantation that is being harvested will be visited, with discussion of this new industry and the prospects of using the residues for bioenergy (FPC).
Lunch will be at the Harris River Estate Vineyard.
Stop 6 will be at the ALCOA Huntley Minesite. Here bauxite is mined following removal of the natural jarrah (*E. marginata*) forest. After logging, the harvest residues could be used for bioenergy (ALCOA/FPC).

A tour booklet will be provided, which will include a map and notes for each of the stops.
The day will conclude with the return to The Vines accommodation near Perth.

TECHNICAL SESSIONS – DAY 3 & 4 - 0900 - 1700 — ***Wednesday 3 & Thursday 4 August, 2005***

Technical sessions will be held at The Vines Resort & Country Club, Swan Valley, Western Australia. Invited and volunteer papers will be presented on topics related to the workshop objectives.

Conference Dinner: Sandalford Vineyard, Caversham. Dress: Informal.

BIOENERGY WORKSHOP – DAY 5 - 0900 - 1200 — ***Friday 5 August, 2005***

On the last day there will be a half day facilitated discussion session on bioenergy prospects for Australia.

In the afternoon business meetings of IEA Bioenergy Tasks 30 and 31 will take place.

INFORMATION FOR PARTICIPANTS

The field tour will occur during mid-winter in Western Australia and it can be very cold and wet in exposed field locations. Day temperatures vary between 5 - 18ºC and night temperatures –2 to 8ºC. It is recommended that participants bring long trousers, warm pullovers, water proof jackets and closed footwear. Hardhats will be provided where necessary.

More information about Western Australia: www.wa.gov.au/aboutwa.html

VENUE & ACCOMMODATION

The Workshop technical sessions will be held the Novotel Vines Resort & Country Club, Swan Valley, Western Australia (www.vines.com.au/index.html).

Participants can readily obtain taxis (cabs) to travel from Perth Airport to the venue.

Bookings for the field trip, conference and accommodation will be made, using the attached forms, with the Forest Products Commission. A series of rooms are being held at the Vines Resort until July 11, so early booking is advised. *There is no guarantee of accommodation at the venue for bookings made after July 11*.

Payment for the field tour and the technical sessions will be made to:

- The Forest Products Commission

Payment for the accommodation will be made to:

- The Vines Resort for accommodation and any meals not covered in the above activities.

Accommodation available includes:

- Single rooms (AUD$116/night)
- 2 Bedroom apartments (AUD$196/night/apartment)
- 3 Bedroom apartments (AUD$271/night/apartment)

Participants traveling on to the IUFRO Conference in Brisbane may find it more convenient to stay at the Vines on the night of Friday 5 August. This will avoid an overnight flight to Brisbane.

Daily Schedule

Wednesday 3 August, 2005. 0830 - 1720

08:30 Welcome and Introduction – Richard Harper, Theo Verwijst, Jim Richardson

08:45 Opening Address. Hon. Alan Carpenter, MLA, Minister for Energy, Western Australia

09:15 Shelley Liddelow, Sustainable Energy Development Office, Western Australia – *Western Australian Government policy on renewable energy.*

09:45 – 10:15 Break

Session 1. Natural Resource Management and Environmental Benefits
Moderators: John Raison/Brendan George

10:15 John McGrath, Ian Dumbrell, Richard Harper, Beth Copeland and Peter Ritson, Forest Products Commission, Western Australia – *Climatic and soil constraints on biomass productivity in south-western Australia.*

10:40 John Bartle, Richard Giles, Richard Mazanec and Dan Huxtable, Department of Conservation & Land Management, Western Australia – *Woody crops and bioenergy in the Australian wheatbelt – the domestication of mallee.*

11:05 Mike Buckton, Forest Products Commission, Western Australia – *Development of a bioenergy industry in Western Australia.*

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11:30 Richard Harper[1], Keith Smettem[2], Nicole Robinson[1] and Stan Sochacki[1], [1]Forest Products Commission, and [2]Centre for Water Research, The University of Western Australia – *Phased forestry systems for salinity control and biomass production.*

11:55 – 13:00 Lunch

13:00 Brendan George[1], Mike Bennell[2] and Trevor Hobbs[2], [1]Department of Primary Industries, New South Wales and [2]Department of Water, Land and Biodiversity Conservation, South Australia – *Short-cycle woody crops for bioenergy production in low-rainfall areas.*

13:25 Ian Nicholas[1], Ian McIvor[2] and Kevin Snowdon[3], [1]Scion, [2]HortResearch and [3]Lake Taupo Development Company, New Zealand – *The opportunities for hardwood bioenergy crops in New Zealand*

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13:50 Daniel G. Neary and Elaine J. Zieroth, USDA Forest Service - *Forest bioenergy system to reduce the hazard of wildfires: White Mountains, Arizona.*

14:15 Sorin Popescu, Texas A&M University, USA - *Developing accurate tools to estimate forest biomass: LIDAR data and processing methods.*

Naresh V. Thevathasan[1], Derek Sidders[2], and Andrew M. Gordon[1], [1]University of Guelph and [2]Canadian Forest Service, Canada - *Tree-biomass production potentials in Agroforestry, Afforestation and Short-rotation Bio-energy Plantation Systems, Canada* POSTER

14:40 – 15:00 Break

Session 2. Environmental Impacts and Site Productivity
Moderators: Tat Smith/Ian Nicholas

15:15 Stephen Schoenholtz, Oregon State University, USA – *Assessing environmental sustainability of silvicultural systems for woody bioenergy production. What have we learned?*

15:40 Gabriella Pracilio[1], Keith Smettem[1], and Richard Harper[1,2], [1]The University of Western Australia and [2]Forest Products Commission – *New technologies for evaluating biomass production potential and environmental benefits.*

16:05 R.A. Sudmeyer[1] and A. Goodreid[2], [1]Department of Agriculture & [2]Department of Environment, Western Australia - *Changes in soil water storage, soil fertility, hydraulic conductivity and agricultural production immediately following harvest of short rotation woody crops in southwestern Australia.*

16:30 J.A. Burger[1], M.H. Eisenbies, S.C. Patterson, W.M. Aust, [1]Virginia Tech, USA – *Soil disturbance, residue removal, and tillage effects on soil and site productivity of biomass plantations in South Carolina.*

16:55 Tim S. Grove[1], Daniel S. Mendham[1], John Bartle[2], Dan Huxtable[2], Stanley J. Rance[3] and Syd Shea[4]; [1]CSIRO, Australia; [2]Dept. of CALM, [3]Forest Products Commission, [4]Oil Mallee Co., Western Australia – *Sustaining oil mallee production in Western Australia – Estimating tree nutrient composition*

Thursday 4 August, 2005. 0830 – 1650

Session 3. Policy Barriers, Constraints and Solutions
Moderators: Jim Richardson/Theo Verwijst

08:30 John Raison, CSIRO, Australia – *Sustainable use of native forest harvest residues for electricity production: a Tasmanian case study.*

08:55 Jim Richardson, Rolf Björheden and Tat Smith, IEA Bioenergy Task 31 – *Too green to burn? Forest certification and implementation of bioenergy projects.*

09:20 Phil Townsend, National Association of Forest Industries, Australia – *The application of the Australian Forestry Standard as a basis for certification of forest bioenergy systems.*[tentative title]

09:45 Bo Dahlin, University of Helsinki, Finland – *Forest energy and certification in Sweden and Europe*.

10:10 – 10:40 Break

10:40 Annette Cowie and David Gardner, Department of Primary Industries, New South Wales - *Competition for the biomass resource: Greenhouse impacts and implications for renewable energy incentive schemes.*

11:05 Andy Hall, Forest Research, UK – *The UK starts to feel the heat.*

11:30 Chyrel A. Mayfield[1], C. Darwin Foster[1], C. Tattersall Smith[2] and Jianbang Gan[1], [1]Texas A&M University, USA and [2]University of Toronto, Canada – *Action steps for bioenergy and bio-based products in the Southern United States.*

11:55 – 13:00 Lunch

13:00 Man Yong Shin[1], Danesh Miah[1], Partha Dewan[2], Kyeong Hak Lee[3], [1]Kookmin University, Korea, [2]University of Chittagong, Bangladesh, [3]Korea Forest Research Institute – *Pattern of the wood energy use by the ethnic community in Chittagong Hill Tracts, Bangladesh: a traditional cooking stove perspective.*

13:25 David Pannell, University of Western Australia - *Socioeconomic issues in achieving uptake of bioenergy crops into established agricultural systems.*

Hitofumi Abe[1], Akio Katayama[2], Sat Samy[3] and Pauline F. Grierson[1], [1]Ecosystem Research Group, School of Plant Biology, The University of Western Australia; [2]Nippon Koei Co.,Ltd; [3]Ministry of Industry, Mines and Energy, Royal Government of Cambodia - *The Potentials of Rural Electrification by Biomass Energy in Cambodia.* POSTER

Session 4. Efficiency and Economics of Forest Energy Operations
Moderator: Rolf Björheden/Bryce Stokes

13:50 Jianbang Gan[1] and C.T. Smith[2], [1]Texas A&M University, USA and [2]University of Toronto, Canada – *Co-benefits of utilizing logging residues for bioenergy production: the case for Eastern Texas.*

14:15 Toshio Nitami[1], Yutaka Tate[2], Rin Sakurai[1], Teruhisa Ohno[3], [1]University of Tokyo, [2]Rengo Co. Ltd., [3]Chichibu City, Japan – *Demand for biofuels at regional energy use and need for road system in mountainous area.*

14:40 – 15:10 Break

15:10 Göran Hedman, Naturbränslen, Sweden – *Technology and economics of forest fuel production*

15:35 Rolf Björheden, Växjö University, Sweden - *The effects on the energy sector of the storm felling in south Sweden.*

16:00 Brad Stennes and Bill White, Canadian Forest Service – *The bioenergy potential of British Columbia's mountain pine beetle damaged forests.* [presented by Jim Richardson]

16:25 Robert N. Coulson[1], Guy L. Curry[1], Maria D. Tchakerian[1], Jianbang Gan[1] and C.T. Smith[2], [1]Texas A&M University, USA and [2]University of Toronto, Canada – *Utilization of plant biomass generated from Southern pine beetle outbreaks.*

Friday 5 August, 2005

0900 - 1200
'Industry Day' – 'Bioenergy in Western Australia: Local Issues and Global Ideas'

Facilitated discussion based on list of questions and issues distributed at beginning of week. To include:

Brief statements by the Leaders of IEA Tasks 30 and 31 on international trends in forest bioenergy and key issues for resolution.

Stephen Schuck, Bioenergy Australia – *Bioenergy in Australia – status and opportunities.*

Don Harrison, Western Power, Australia – *Western Power and their approach to bioenergy.*

13:30 - 16:00

Task 30 and 31 Business Meetings.

INSTRUCTIONS TO PRESENTERS/AUTHORS

PRESENTATIONS

There will be 25 minutes allocated (20 minutes talk plus 5 questions/discussion) for each presentation. Slide and PowerPoint presentation equipment will be available for oral presentations. PowerPoint files in CD or USB format must be delivered to local organizers (see Stephanie Hutson at registration), preferably the evening before the presentation to ensure smooth presentation and avoid electronic hitches. Use of personal laptop computers for presentation will not be permitted. PowerPoint presentations will be collected and made available after the workshop on the Task 31 website and/or on CD to all workshop participants.

Poster boards of size 1 x 2 meters will be available for your use. Printing and copying facilities will be available during the workshop.

MANUSCRIPTS

It is expected that the workshop proceedings will be published in Biomass and Bioenergy. Manuscripts will be refereed, generally by others who attend the workshop. Full papers written in English, from both oral and poster presentations will be considered for inclusion in the proceedings. Slide decks will not be included. It is imperative that you follow the "Guide for Authors" as closely as possible in formatting your manuscript. From the home-page (www.elsevier.com/locate/biombioe) click on the Author Gateway (under Authors), and then "Guide for Authors," under the heading Submission Information. Please submit a single hardcopy and an electronic version of final paper to Oana Popescu either: at the workshop; by post (Dept. of Forest Science, Texas A&M University, College Station, TX 77843-2135, USA); or email (opopescu@tamu.edu). **Papers will be accepted until October 31, 2005.**

IEA Bioenergy Task 30 contacts

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Australian Leader:	Brendan George, Australia; brendan.george@dpi.nsw.gov.au
Website:	http://www.shortrotationcrops.com

IEA Bioenergy Task 31 contacts

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Australian Leader:	John Raison, Australia; john.raison@csiro.au
Website:	http://forestry.tamu.edu/Links/IEA_Bioenergy_Task_31.htm

Bioenergy Australia contacts

Manager:	Steve Schuck, Australia; sschuck@bigpond.net.au
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Conference contacts

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	Richard Harper, Australia, richardh@fpc.wa.gov.au
	John Bartle, Australia; johnb@calm.wa.gov.au
Conference Administration	Stephanie Hutson, stephanieh@fpc.wa.gov.au

ABSTRACTS

Shelley Liddelow, Sustainable Energy Development Office, Western Australia – **Watts in the Wind and the Woods**

Abstract

Renewable energy is a key component of the Western Australian Government's strategy to manage the environmental impact of energy use. Western Australia's energy system is characterised by a grid with long lines (and therefore line losses) covering the major population centres in the south west. Generation is largely from coal and natural gas, which the State has in abundance. A very large though sparsely populated area of the State is not connected to the grid and this has provided opportunities for renewable energy generation. Established policies have focussed on renewable energy in off grid areas, increasing the penetration of solar water heating and removing barriers to increased renewable energy on the main grid through electricity reform. New policies that include a target for renewable energy on the main electricity grid and increasing its use on the fringes of the grid reflect an increasing commitment to greater energy supply sustainability. There is an ongoing focus on reducing barriers to renewable energy generation and demand management through electricity market reform and placing renewable energy projects where they are most effective. The national Mandatory Renewable Energy Target and Green Power programs are important drivers at a national level and Australia's States and Territories are investigating options for increasing the potency of national drivers. State strategies include a significant focus on energy efficiency and are intended to promote and raise awareness, reduce greenhouse gas emissions, provide a more reliable power supply to fringe of grid and off-grid communities, tackle land care issues and support regional development. Innovative projects such as the Narrogin IWP plant have the potential to be a critical component in managing the considerable environmental issues confronting regional Western Australia.

Session 1. Natural Resource Management and Environmental Benefits

1.1 *John McGrath, Ian Dumbrell, Richard Harper, Beth Copeland and Peter Ritson, Forest Products Commission, Western Australia* – **Climatic and soil constraints on biomass productivity in south-western Australia**

Abstract

In the seasonally dry Mediterranean climate of south-western Australia, biomass productivity is strongly linked to water availability. Although this is primarily driven by rainfall and evaporation, site conditions and management influence the degree to which this climatic potential is met. Soil water storage capacity is important in determining both overall productivity and in providing a buffer against droughts. Topography and aspect can influence growth by controlling the availability and demand for moisture. Several studies have found strong associations between tree deaths and the occurrence of shallow soils.

Nutrient supply also influences biomass productivity. Nutrient deficiencies that often limit agricultural production (e.g. phosphorus, potassium, zinc, copper and manganese) are less likely to occur in trees grown on farmland. Nitrogen responsiveness is determined by the supply of nitrogen and the availability of water, either from rainfall, stored soil water or run-on. There is a large potential to increase productivity on high rainfall sites with nitrogen deficient soils whereas in lower rainfall areas, nitrogen applications may predispose trees to drought deaths.

In all environments where there is sufficient water storage capacity in the soil profile to accommodate annual rainfall, plantations have the capacity to eliminate annual recharge. Additionally, plantations have the capacity to rapidly consume the stored water that has accumulated under the annual crop and pasture systems used in southern Australia. A range of species deplete soil water to depths of 10 meters within 6-8 years of planting. The implications of this depletion on the sustainable production of biomass from short rotation, un-thinned plantations require resolution.

Irrespective of annual rainfall, management systems need to accommodate the risk of drought in a climate where rainfall is variable on both a seasonal and annual basis. The net water supply to trees, and thus biomass productivity and drought avoidance, can be manipulated by plantation density and tree arrangement. Manipulating the location and planting configuration, for example by locating plantings in lower slope positions or as strips integrated with agriculture will become more important in drier areas, as will site engineering that diverts water to trees. The extensive capacity of trees to exploit water laterally can be used to design effective recharge control systems.

1.2 John Bartle, Richard Giles, Richard Mazanec and Dan Huxtable, Department of Conservation & Land Management, Western Australia – **Woody crops and bioenergy in the Australian wheatbelt – the domestication of mallee**

Abstract

Extensive agricultural development in southern Australia has occurred only over the past 120 years. During this time some 50 million ha of low relief, winter rainfall dominant (300-600 mm/year) native woodland was converted to shallow rooted, annual winter-growing crops and pastures. This change in vegetation cover has reduced evapotranspiration by a small but significant amount. Surplus soil water is accumulating in groundwater systems, mobilising previously stable stored salts and discharging saline water at low positions in agricultural landscapes. While this 'wheat and sheep' agriculture has been economically successful it is, particularly through salinisation, eroding natural resources capital to an extent that is not sustainable.

One of the options to improve sustainability is to complement the annual agricultural plant species with commercially attractive tree (or woody) crop species. Since conventional forestry species from adjacent higher rainfall areas are not commercially viable in this rainfall zone, new woody crops must be developed. The diverse and vigorous native mallee eucalypt species that were a prominent component of the prior native woodlands were an obvious prospect for domestication. Over the past 12 years considerable progress has been made to develop mallee to the stage where it can be a commercially viable component of more sustainable agricultural systems. This paper reviews this development.

Technical development has been advanced in parallel with fostering farmer participation and investigating processing options. Some 20% of Western Australian wheatbelt farmers (~1000 farmers) have planted more than 12,000 ha of mallee mostly in dispersed belts designed to capture surplus water from the adjacent annual crops and pastures. This demonstration of mallee production potential has attracted commercial feasibility investigation and the investment of $14 million in an operational assessment of the viability of integrated biomass processing.

The review focuses on technical matters relating to mallee biomass production. It deals with these in the natural sequence from selection of species including resolving taxonomic issues, germplasm collection and testing leading into breeding and seed production, nursery practice, establishment methods, management issues especially design of planting configuration and the issues of yield prediction and growth modelling, harvest regime and the supply chain all the way to the processors receiving point. It does this within the context of the twin objectives of achieving commercial viability and salinity control.

1.3 Mike Buckton, Forest Products Commission, Western Australia – **Development of a bioenergy industry in Western Australia**

Abstract

The Western Australian Forest Products Commission (FPC) has been examining methods to increase the utilisation of forest residues from plantations. There are significant amounts of residue material in plantations associated with both long-rotation (*Pinus radiata, Pinus pinaster*) and short-rotation (*Eucalyptus globulus*) species and this resource may represent a resource for bioenergy. Changing technologies, markets and government initiatives such as the Mandatory Energy Renewable Target (MRET) have provided opportunities for this waste material to be used as a resource for bioenergy production.

Developing a viable business based on forest residues presents certain challenges, as the capital investment is usually large and the economics are generally marginal. A Request for Proposals (RFP) procedure was undertaken in January 2003. It was recognised that prospective proponents would conduct feasibility studies, and the investment in these studies would only occur if the proponents were given guarantee of resource subject to the outcome of the feasibility study. Once the feasibility studies were completed, the proponents submitted a Business Plan to the FPC, this taking into account issues such as contractual conditions, price, resource quantity and product specifications. Recommendations were endorsed by the State Tenders Committee in March 2003 and two proponents, WA Green Power and Babcock and Brown were selected. Contracts are expected to be signed by September 2005.

The presentation will discuss this process, major development issues and some suggestions on the successful completion of a bioenergy project based on forest residues.

1.4. Richard Harper[1], Keith Smettem[2], Nicole Robinson[1] and Stan Sochacki[1], [1]Forest Products Commission, and [2]Centre for Water Research, The University of Western Australia – **Phased forestry systems for salinity control and biomass production**

Abstract

The salinization of land and water resources is a major environmental problem in Australia, with up to 17 Mha of farmland likely to be affected. This hydrologic imbalance has been caused by the replacement of deep-rooted natural vegetation by shallow-rooted agricultural plants, and reforestation is thus required. Treatment scales are in the order of several million ha. The hydrologic effects of trees in these dryland-farming systems, however, are often localized, and belts of trees can compete with crops. Dispersal of trees across paddocks interferes with crop production.

Another approach is to insert short rotations (3-5 years) of trees into existing agricultural systems on a 20-25 year cycle. The premise is that the trees will rapidly de-water soil profiles to several metres depth and thus create a buffer of dry soil, with this being refilled during the subsequent agricultural phase. The plant produced would be suitable for biomass energy production.

We investigated this premise in three ways:

1. Modelling, with this suggesting that the system may work in the deep (>10 m) soil profiles, that are common in south-western Australia, but not in areas with free water tables or deep sandy soils with high rates of recharge.
2. Examination of 15 existing *Eucalypt* plantings across south-western Australia. There was evidence of soil water depletion to 10 m depth after 7 years, across a range of soil conditions.
3. Field experimentation, on land normally used for wheat production near Corrigin, WA (300 mm/year annual rainfall). Here we manipulated tree species (*Eucalyptus globulus*, *E. occidentalis, Acacia celastrifolia, Pinus radiata* and *Allocasuarina huegeliana*, planting density (500, 1000, 2000 and 4000 trees/ha) and fertility to determine (a) if the premise of soil water depletion to depths of several metres in 3-4 years was possible, and (b) if it is feasible to accelerate the rate of water depletion, and hence decrease the duration of the forestry phase. Soil water beneath *E. occidentalis* at 4000 trees/ha was depleted to 6.5 m depth after 34 months.

This paper discusses these promising results, and the technical and economic issues that need resolution before this farming system can be introduced in southern Australia.

1.5 Brendan George[1], Mike Bennell[2] and Trevor Hobbs[2], [1]Department of Primary Industries, New South Wales and [2]Department of Water, Land and Biodiversity Conservation, South Australia – **Short-cycle woody crops for bioenergy production in low-rainfall areas**

Abstract

The need for large-scale land use change to address environmental issues such as salinity are well known within Australia. How to economically engage farmers to allow them to achieve this change is not, as yet, well established nor occurring. One proposed system of introducing deep-rooted crops back into the environment is based on a multiple outcomes model with environmental and economic products. Bioenergy production can also address this multiple benefit model and we are investigating native woody species that can be used as a feedstock for bioenergy and other products such as medium density fibre board (MDF) and oil whilst trying to meet environmental goals.

We are investigating the opportunity for species to grow in different planting and harvesting systems including:

- Short cycle coppice (SCC) – plants are continuously harvested for production and remain embedded in agricultural system with different planting configurations such as block or alley plantings;
- Short cycle phase (SCP) – plants grown and harvested with residual removed when role (e.g., dewatering of the soil profile) is met;
- Long cycle (LC) – a more traditional view of woody plants where species are selected and grown over larger time frame for wood products e.g., sawlogs);
- Fodder (F) – species selected that are capable of inclusion into the livestock production systems whilst capable of developing and maintaining root systems to access water deeper into the profile.

Species growing naturally and in planted stands in low to medium rainfall areas of southern Australia (250 – 700 mm) have been identified and sampled for chemical and physical properties (e.g., wood density, ability to coppice). These attributes are then considered in relation to existing or potential large-scale markets (such a MDF) and what planting system in which they can be employed.

Further field testing of selected species (e.g., Acacia saligna, Attriplex nummularia and Eucalyptus polybractea) aims to quantify basic parameters such as survival, growth rate and measure key attributes including wood properties. This information is used in the development and testing of a Regional Industry Potential Analysis (RIPA). The RIPA allows for consideration of other parameters important in industry development including market opportunities, infrastructure limitations and climate. We will outline and discuss the some uses for the RIPA analysis in this paper.

1.6 Ian Nicholas[1], Ian McIvor[2] and Kevin Snowdon[3], [1]Scion, [2]HortResearch and [3]Lake Taupo Development Company, New Zealand – ***The opportunities for hardwood bioenergy crops in New Zealand***

Abstract

Exotic hardwoods in New Zealand provide an opportunity for bioenergy production from four genera, Eucalyptus, Salix, Acacia and Populus. Pilot studies of stands from these genera have all shown productivity of around 20 Oven Dry Tonnes/ha/year or better. These confirm that biomass can be produced, but the issue of economics and barriers to production must be addressed to realise industrial scale planting. Bioenergy crops can also provide many other benefits to land use systems such as improvement in water quality, nutrient stripping, fodder crops or fibre utilisation for wood products. In the short term these co-products may be the driver that provides an opportunity to establish hardwood bioenergy crops.

In New Zealand hardwood short rotation crops, although currently used to a minor extent for energy production, are viewed as being strategically important for the long-term implementation of bioenergy projects to supplement other biofuel sources such as the residues from the processing of the pine forests.

This paper explores the opportunities for hardwood bioenergy crops in New Zealand.

1.7 Daniel G. Neary and Elaine J. Zieroth, USDA Forest Service **- Forest bioenergy system to reduce the hazard of wildfires: White Mountains, Arizona**

Abstract

In a ground-breaking effort starting in 2005, the USDA Forest Service is planning to reduce the threat of catastrophic wildfires like the Rodeo-Chediski Fire of 2002 by inaugurating a series of forest thinnings for bioenergy. The start-up project is in the Nutrioso area of the Alpine Ranger District, Apache-Sitgreaves National Forest. "The Nutrioso Wildland/Urban Interface Fuels Reduction Project", under the authority of the Healthy Forest Restoration Act of 2003, addresses the existing condition of the forest, defines the desired condition of the forest, and the proposes actions that will result in a healthier forest and a reduced risk from wildfire. The Nutrioso Project is part of larger-scale, small-diameter tree thinning covering an area of 60,700 ha over a 10-year period. The Project encompasses 21,309 ha which is 79% National Forest Lands, 18% private lands, and 5% State of Arizona lands. A variety of thinning and fire prescriptions have been established depending on slopes, road access, and distance from private land. The mostly small-diameter (<12 cm) trees in ponderosa pine and mixed conifer stands are being sold under a "Stewardship Contract" for utilization in small power plants (<5 Mw), and wood heating pellet manufacturing facility. The outlet for the wood fuel pellets is the growing market for house and business heating, and co-generation fuel in 615 Mw coal-fired power plant at Joseph City, Arizona. This paper examines the scope, costs, and environmental tradeoffs of this pioneering forest bioenergy project in the southwestern USA.

1.8 Sorin Popescu, Texas A&M University, USA - **Developing accurate tools to estimate forest biomass: LIDAR data and processing methods**

Abstract

Airborne LiDAR (Light Detection and Ranging) is a proven technology that can be used to accurately assess aboveground forest biomass and bio-energy feedstocks. The overall goal of this study was to present LIDAR data capabilities, processing software developments, and the approach for assessing forest biomass in forest settings typical for the southeastern US. A LIDAR software application, TreeVaW, was developed and used to extract forest inventory parameters at individual tree level from a LIDAR-derived canopy height model. Testing the software was done with LIDAR data sets collected over pines and deciduous trees in Virginia and Texas, USA. LIDAR-measured parameters at individual tree level (height, crown diameter) were used with regression models and cross validation to estimate plot-level field inventory data of above ground forest biomass. Maximum R^2 values for estimating biomass with LIDAR data sets from Virginia, USA, were 0.32 for deciduous trees (RMSE 44 Mg/ha) and 0.82 for pines (RMSE 29 Mg/ha), with circular plots of 0.04 acres. Current work investigates results obtained for processing LIDAR data in Texas, USA, with ground-truth data collected over 0.1 and 0.01–acre plots in the summer of 2004. Accurate methods of estimating forest biomass allow a reliable assessment of the supply of forest biomass for energy production at scales ranging from stand to regional level.

POSTER

Naresh V. Thevathasan[1], Derek Sidders[2], and Andrew M. Gordon[1], [1]University of Guelph and [2]Canadian Forest Service, Canada - **Tree-biomass production potentials in Agroforestry, Afforestation and Short-rotation Bio-energy Plantation Systems, Canada**

Abstract

Of the estimated 140 million ha of non-forested land available for agroforestry and afforestation establishment in North America, 50 to 57 million are in Canada. In order to exploit this potential land-base, several agroforestry, afforestation and short-rotation bio-energy initiatives are currently underway. Under the auspices of the Canadian Biomass Innovation Network (CBIN), ten research centres will cooperate to develop short-rotation plantation/agroforestry systems for energy production and GHG reduction. Approximately 1.3 million hectares will be established by 2025, with the potential to contribute 15-23 million tonnes of feedstock per year.

The University of Guelph, in collaboration with the Canadian Forest Service is currently investigating tree-biomass production options through agroforestry, afforestation and short-rotation bio-energy plantations in southern Ontario, Canada. In agroforestry land-use systems, where trees are integrated at low densities (120 trees ha^{-1} or less) into agricultural systems with conventional field crops or with pasture, initial results suggest that fast growing hybrid poplars can accumulate significant amount of biomass and carbon, almost 4 times that seen in monoculture field crop or pasture systems. Results from agroforestry (low tree density), afforestation (medium tree density) and short-rotation bio-energy (high tree density) land-use systems are discussed below.

When carbon credit schemes become operational, industries that emit GHG may be required to invest in C credits: agroforestry and afforestation practices may become an attractive land-use option.

<u>Session 2</u>. Environmental Impacts and Site Productivity

2.1 Stephen Schoenholtz, Oregon State University, USA – **Assessing environmental sustainability of silvicultural systems for woody bioenergy production. What have we learned?**

Abstract

Sustainable management of silvicultural systems for woody bioenergy production relies on a viable interplay among environmental, economic and social considerations. From the environmental standpoint, we have a good understanding of both positive and negative off-site influences of forestry practices regarding water quality. Practical management options are available that can achieve silvicultural goals while effectively maintaining water quality. In some cases, water quality is improved by silvicultural systems, depending on prior land uses. However, questions remain concerning forest management practices for woody biomass production and their effects on long-term site productivity. This is because outcomes of management effects may take decades to be manifested and require appropriately designed long-term studies.

Published literature suggests several management principles that should insure maintenance of site productivity. Conservation of organic matter and protection of soil physical properties are most often sited as key concerns. Numerous studies established several decades ago to assess long-term effects of forest harvesting treatments provide opportunities to continue or reestablish monitoring and thereby gain knowledge of long-term soil responses. If studies are (1) well-documented, (2) of sufficient plot size, (3) compare gradients of treatments covering a full range of impacts, and (4) have sufficient replication, then answers regarding long-term effects of forest management systems on soil properties and processes affecting nutrient pools and availability, carbon sequestration, and comparative productivity of tree growth can provide insights without the need to initiate new studies. Many of the experiments established in the 1980’s in response to concerns about harvesting effects on long-term site productivity are available to enhance our understanding of sustainability. Several examples of these types of studies relevant to environmental sustainability of woody biomass systems will be discussed.

2.2 Gabriella Pracilio[1], Keith Smettem[1], and Richard Harper[1,2], [1]The University of Western Australia and [2]Forest Products Commission – **New technologies for evaluating biomass production potential and environmental benefits**

Abstract

Reestablishment of a perennial vegetation system in dryland agricultural areas is gaining momentum due in part to the perceived benefits of salinity control and carbon sequestration. Rooting depth of perennial vegetation considerably exceeds annual crops and therefore existing soil survey maps over the depth of traditional agricultural crops are of limited value in determining suitable locations for new perennial systems in the landscape. Furthermore, the scale of existing soil survey is too coarse for farm scale planning. In this study, geophysical methods were used to enhance the spatial resolution of mapping regolith properties that limit the growth of oil mallees. For a property located near Kalannie, South-East of Perth, Western Australia, oil mallee (*Eucalyptus polybractea*) plant growth was regressed against magnetic, radiometric, electromagnetic, topographic and landscape location data, in order to understand the influence of regolith properties on plant growth. A preliminary regression tree analysis indicates that the sand plain, as identified by the gamma radiometric data was the best producing regolith unit. Poor producing regolith units included lateritic gravel, carbonate and alluvium soils. The sand unit was split according to northing location, representing landscape catenary position at the field site. The most productive areas were in the mid to upper (north) landscape, where the deepest sand layer is expected. The sand unit is underlain by a hard silcrete layer, with depth decreasing in a north-south direction. Such sands are underlain by a hard silcrete layer, likely to be a limiting factor to root growth in the northern agricultural region of Western Australia

2.3 R.A. Sudmeyer[1] and A. Goodreid[2], [1]Department of Agriculture & [2]Department of Environment, Western Australia - **Changes in soil water storage, soil fertility, hydraulic conductivity and agricultural production immediately following harvest of short rotation woody crops in southwestern Australia**

Abstract

Growing short rotation woody crops (SRWC) in rotation with conventional agriculture is a prospective method for ameliorating degraded soils, particularly those at risk from salinisation. This presentation details changes in soil water storage, soil fertility, hydraulic conductivity and crop and pasture growth in the first three years after harvesting SRWCs at two sites in Western Australia.

This trial has demonstrated that where the roots of a SRWC can penetrate deeply into the subsoil it is possible to develop soil water deficits large enough to subsequently allow several decades of conventional agriculture before groundwater recharge is resumed. At one site, *Eucalyptus polybractea* dried the soil to at least10 m, creating a soil water deficit of 1350 mm within six years of planting. It is estimated that annual crops and pasture could be grown at this site for 68 years before the soil again reaches field capacity. At the other site, *E. globulus* tree roots penetrated only 4 m and the subsequent soil water deficit would only allow 2-4 year of agriculture before the soil is again at field capacity.

Soil fertility was generally reduced after the SRWC, though there was some evidence of nutrient cycling in deep duplex soils with infertile sand topsoils. The hydraulic conductivity of the topsoil and clay subsoil was not measurably increased immediately and 2 years after harvesting the SRWC.

Reduced soil fertility limited crop and pasture growth in the first year after the SRWC at one site, while reduced plant available water limited crop and pasture growth for two years after the SRWC at the other. Monitoring is continuing to determine longer-term changes in soil water content and crop and pasture productivity.

Keywords: phase farming with trees, salinity, agroforestry

2.4 *J.A. Burger[1], M.H. Eisenbies, S.C. Patterson, W.M. Aust, [1]Virginia Tech, USA* – **Soil disturbance, residue removal, and tillage effects on soil and site productivity of biomass plantations in South Carolina**

Abstract

To be sustainable, soil and site productivity of biomass production systems must withstand organic residue and nutrient removal and resist physical impacts from harvesting equipment. In a long-term, operational-scale field study we tested the hypotheses that wet-weather logging disturbance and residue removal had no short term or stand closure effect on loblolly pine productivity, and that row bedding had no effect on ameliorating disturbed soils. These hypotheses were tested on three plantations on the Atlantic Coastal Plain near Charleston, SC. These sites are commonly referred to as wet pine flats with fertile soils consisting mostly of Aqualfs. Results at age two showed that wet-weather harvesting reduced early tree growth and that row bedding did not always ameliorate the disturbance condition. Soil drainage and air/water balance were the soil processes most adversely affected; a measure of the least-limiting water range explained 60 percent of the variation in early tree growth. By stand closure the wet-harvested, bedded sites had significantly greater biomass than the dry harvested bedded sites; there were no significant differences between the non-bedded sites. However, ranking productivity at stand closure showed that there were no significant changes in soil-site productivity due to the treatments among the bedded sites. Our study shows that these inherently fertile sites are resistant to potential losses in fertility due to intensive forest management, and that they recover quickly from soil physical disturbance especially when row bedded. At this point, there is no evidence that wet-weather harvesting and residue removal or displacement had a long-term effect on soil and forest productivity of these sites. Despite serious surface disturbances caused by harvesting wet sites, these particular forest soils were both resistant and resilient to damage. Intensive management typical of the region appears to be sustainable on these sites even during wet-weather conditions; they could be trafficked in order to protect more sensitive sites.

Key words: Biomass harvesting, plantation management, management impacts, sustainable management, rank diagnostics

2.5 Tim S. Grove[1], Daniel S. Mendham[1], John Bartle[2], Dan Huxtable[2], Stanley J. Rance[3] and Syd Shea[4]; [1]CSIRO, Australia; [2]Dept. of CALM, [3]Forest Products Commission, [4]Oil Mallee Co., Western Australia – **Sustaining oil mallee production in Western Australia – Estimating tree nutrient composition**

Abstract

Oil mallee trees are being widely planted in the agricultural regions of south-western Australia for multiple benefits, including water utilization for salinity mitigation, wind and erosion control, and farm income diversification. The industry is still in its formative stages, but it is anticipated that several integrated wood processing plants converting biomass into energy and other value-adding products will be built throughout the oil mallee growing region. Investment in such large infrastructure projects requires that production of the primary resource can be sustained over several harvest cycles. One of the key reasons for productivity decline in other short-rotation forestry systems is declining soil fertility caused by net export of nutrients and organic matter. The aim of this study was to develop procedures to estimate the export of biomass and nutrients under a range of different conditions of plantation age, region, species and soil fertility.

In total, 139 trees were sampled from tree belts of varying age (1-10 years) located on contrasting soils (high and low fertility) in 2 regions (high and low rainfall) of the WA wheatbelt. Three species were also examined, 1 common to the 2 regions (*Eucalyptus loxophleba* ssp. *lissophloia*), and 1 other one from each of the regions (*E. horistes*/*plenissima* in the north-eastern wheat belt, and *E. polybractea* in the south-western wheat belt). Relationships were developed to predict standing biomass and nutrient (N, P, K, Ca, Mg) content from simple non-destructive tree measurements. Up to 98% of the variation in stem biomass (including wood, branches and bark) and 95-97% of the variation in nutrient content could be explained by relationships with stem basal area and tree height. The relationships differed among species but were not generally affected by soil fertility. In contrast, relationships for canopy components (leaves, twigs, fruit) of each species were significantly influenced by region and fertility. Relationships were therefore less generic than for the stem components. These relationships were used to estimate the biomass and nutrient composition of tree belts at representative sites. In this paper, we examine efficacy of different non-destructive methodologies for estimating standing biomass and nutrients.

<u>Session 3</u>. Policy Barriers, Constrains and Solutions

3.1 John Raison, CSIRO, Australia – **Sustainable use of native forest harvest residues for electricity production: a Tasmanian case study**

Abstract

Forestry Tasmania has established a wood-processing centre in the Southern forests of Tasmania (Southwood Project). A key component of this centre will be a wood-fired power station, to be fuelled mainly by native eucalypt forest harvesting residues. Forestry Tasmania wishes to sell native forest harvesting residues from existing commercial operations as the fuel source for the power station. At present much of these residues are consumed in slash burns as part of the forest regeneration process. The 35-megawatt power station will provide the energy required to run the entire development, and feed most of the electricity generated into the grid for general consumption.

Extraction of industrial fuelwood is a new activity in Tasmania's wet eucalypt forests, and as a consequence there are uncertainties associated with the economic supply of fuel, the nature and intensity of harvest on particular logging units, and the impacts of the operation on a range of environmental values. In particular, the impacts of residue removal on biodiversity at both the logging-unit (coupe) and landscape scale are poorly understood. The fuelwood resource is highly spatially variable as a result of prior fire and logging history, and will vary over time because of changing cutting patterns and rates of conversion of native forest to plantations. CSIRO (2002) conducted a review of the science relevant to the sustainable use of harvest residues in Tasmanian wet eucalypt forests and reached the following conclusions:

- Existing planning procedures seem adequate for the broad assessment of the availability of fuelwood during the initial years of the project, but there is a need to strengthen the planning system to provide better estimates of the nature of fuelwood on individual harvest units, and for predicting the distribution of coarse woody debris (CWD) habitat across the total forest estate.
- Harvest of fuelwood has the potential to limit the successful regeneration and early growth of eucalypts because of increased soil physical disturbance, and lower fire intensities resulting from fuel removal. Both of these potential risk factors can be adequately managed.
- Provided that harvesting operations are carefully controlled to minimise topsoil disturbance, and that regeneration is achieved rapidly, then site productivity and the diversity of vascular plants can be maintained. Retention of undisturbed 'islands' to protect habitat within logging units, and return of ash from the bioenergy plant to forest sites will help mitigate the impacts of fuelwood harvest.
- The continuity of CWD habitat is interrupted by the existing clearfall, burn and sow (CBS) silvicultural system, and harvest of fuelwood may exacerbate the problem. An interim, 'precautionary', approach to management of CWD is proposed that involves:
- In the short-term, development of management guidelines for some CWD retention and its creation into the future. These should focus on the logging-unit scale, and the larger (>1m diameter) components of both existing CWD and defective green bolewood.
- In the medium-term, development of estimates of temporal and spatial change in CWD that can guide the management of CWD spatially in the landscape.
- The effect of fuelwood harvest on the greenhouse gas balance of all harvesting scenarios examined was highly positive, and was dominated by the offset of fossil fuel emissions during the generation of electricity. There is likely to be only a small difference in the C stock in the forest as a result of fuelwood harvest over an 80-100 year forest rotation. Harvesting of fuelwood may also provide a

greenhouse benefit by lowering emissions of non-CO_2 greenhouse gases resulting from slashburning.

Since harvesting operations will regenerate much more (~30-70%) residue than is required to supply the Southwood power plant, there are options to vary both the nature (quantity and composition) of fuelwood harvest, and the location of harvested areas in the landscape. The dual initial approach proposed above to the management of CWD over time can be considered as ‘precautionary’ until a more solid scientific base is established. Emphasis should be given to retention of the larger (> 1m diameter) components of both existing CWD and defective green bolewood, because these will be more long-lived and will be in short supply under CBS silviculture and 100-year forest harvest cycles.

The analysis supporting the above conclusions will be presented.

3.2 Jim Richardson, Rolf Björheden and Tat Smith, IEA Bioenergy Task 31 – **Too green to burn? Forest certification and implementation of bioenergy projects**

Abstract

Concerns about the possible environmental, economic and social effects of greatly increased use of forest biomass for energy create obstacles which deter decision-makers from clear commitment to this renewable energy source. Third-party certification has become an increasingly accepted tool for satisfying consumers that conventional forest products such as lumber, paper, panelboard and furniture originate from sustainably managed forests. Existing forest certification schemes could readily incorporate forest fuel as a certified 'green' product, taking into consideration such criteria as site productivity, other environmental impacts, carbon neutrality, energy balance, economics and social considerations. While other components of the energy supply chain also need to be considered, assurance of sustainable green fuel production could remove some of the obstacles to increased use of forest residues for energy and improve renewable energy supplies. This presentation offers a preliminary analysis of criteria to incorporate in a certification procedure for forest energy, and discusses some of the issues involved in obtaining acceptance of such a scheme.

3.3 Phil Townsend, National Association of Forest Industries, Australia – **The application of the Australian Forestry Standard as a basis for certification of forest bioenergy systems**.

Abstract

3.4 Bo Dahlin, University of Helsinki, Finland – **Forest energy and certification in Sweden and Europe**

Abstract

There are a number of different certifications. The ISO (International Organisation for Standardization) offers different types of certification like the ISO 9000 and ISO 14000 families of management standards. However, those certifications are mainly for business administration and production management. Although important, technical and economical certification will not be covered in depth in by this presentation. Additionally, there are various types of environmental certifications and standards. For forestry and forest products, two standards are of special interest in northern Europe: the FSC (Forest Stewardship Council) and the PEFC (Pan-European Forest Certification, also; Programme for the Endorsement of Forest Certification schemes). Both these standards are resting on the three fundaments for sustainability: economy, ecology and social values. The current standards regarding forest energy of the two certification systems are described. Further, from a perspective of certification needs, an evaluation of how the utilisation of forest energy affects economy, ecology and social values is made.

3.5 Annette Cowie and David Gardner, Department of Primary Industries, New South Wales -
Competition for the biomass resource: Greenhouse impacts and implications for renewable energy incentive schemes

Abstract

Internationally, interest in renewable energy has surged in response to concern about climate change. In Australia, the Mandatory Renewable Energy Target (MRET) scheme, which commenced in 2001, targets a 95000GWh increase in renewable electricity generation by 2010. Hence, along with other renewable energy sources, bioenergy projects are being developed. This growing interest in bioenergy is causing increased demand for biomass resources and, in some instances, leading to competition for biomass between current uses and bioenergy. This study assesses the greenhouse mitigation impacts of alternative uses of wood processing residues, *viz*., for composite products or bioenergy.

Sawmill residues are an attractive feedstock for a bioenergy project, in that they are already collected, dried and comminuted so require little further processing. For the same reasons, sawmill residues are also valued as feedstock for manufacture of particleboard.

Where the development of a bioenergy project diverts the feedstock currently used for particleboard, the particleboard manufacturer will need to source feedstock from purpose-grown plantations. Greenhouse gas emissions from the manufacture of particleboard will be increased, due to the requirement to harvest, transport, chip and dry feedstock, and carbon stock in forests will decrease.

This study assesses the increase in GHG emissions for particleboard manufacture for a theoretical plant processing 100 000 dry tonnes feedstock per annum. If this feedstock is used in a bioenergy plant, it displaces 205 000tCO_2 emissions.

However, emissions in the particleboard plant increase by about 34 000tCO_2, equivalent to 17% of the fossil fuel emissions displaced by the bioenergy plant. This result is influenced particularly by the fossil fuel source displaced, the relative efficiency of conversion to electricity in the fossil fuel and bioenergy plants, and the efficiency of the drier in the particleboard plant.

Under the MRET scheme, approved generators earn Renewable Energy Certificates (RECs) for power generated from eligible sources of renewable energy. Calculation of RECs is based on the quantity of power generated; there is no assessment of the emission reduction benefits of different electricity sources. This example illustrates that indirect consequences can reduce the net GHG mitigation benefits of a bioenergy project. Such “leakage” should be taken into consideration in determining the credit earned by bioenergy projects. In this example, the calculation of the green energy credit attributable to the bioenergy project under the MRET scheme should acknowledge that the net GHG mitigation is, in reality, about 17% less than the apparent benefit.

3.6 Andy Hall, Forest Research, UK – **The UK starts to feel the heat**

Abstract

Woodfuel is not **new**: wood has been used as a fuel since humans first learned how to make and harness fire.

But woodfuel is **new again**, and going through resurgence which is helping to replace fossil fuels for heat and electricity generation, in an attempt to cut greenhouse gases and other emissions. Climate change is a reality and using woodfuel as a renewable energy source will help.

Many areas of the world are well ahead in their use of woodfuel and other sustainable energy sources and the UK is in the process of catching up.

In order to better understand our current position there is a need to look at our national policy framework, the Forestry Commissions role, the role of the private sector, research and the UK experience in terms of achievable goals and barriers to development.

Keywords: UK; woodfuel; fossil fuels, climate change, sustainable energy; renewable energy; national policy framework; Forestry Commission, private sector; research; achievable goals; barriers.

3.7 Chyrel A. Mayfield[1], C. Darwin Foster[1], C. Tattersall Smith[2] and Jianbang Gan[1], [1]Texas A&M University, USA and [2]University of Toronto, Canada – **Action steps for bioenergy and bio-based products in the Southern United States**

Abstract

The forests of the Southern United States produce large volumes of unused biomass in the form of harvest residue and small diameter trees. Although support and enthusiasm are growing regarding the prospect of greater utilization of this biomass significant barriers exist. Using the seven critical components in the bioenergy and bio-based products value chain, as identified by IEA Task 31, focus groups were used to identify barriers, opportunities, and strategies for increased utilization of forest biomass in the Southern United States. Participants included handpicked experts from each of the seven component areas. Six common themes emerged from the focus groups. Market creation, infrastructure development, community engagement, incentives, collaboration, and education will all be critical in the future development of the biomass industry. Specific recommendations are provided for addressing these issues in the Southern United States.

Keywords: Biomass, forest, education, collaboration, incentives, United States

3.8 Man Yong Shin[1], Danesh Miah[1], Partha Dewan[2], Kyeong Hak Lee[3], [1]Kookmin University, Korea, [2]University of Chittagong, Bangladesh, [3]Korea Forest Research Institute* – **Pattern of the wood energy use by the ethnic community in Chittagong Hill Tracts, Bangladesh: a traditional cooking stove perspective [presented by Jim Richardson]**

Abstract

In the rural areas in Bangladesh, the foods are cooked mainly in the traditional cooking stove where biomass fuels are commonly used as energy because of the unavailability of the natural gases. A large quantity of greenhouse gases is emitted from these stoves because of the inefficiency of biomass burning leading to the wastage of the burning capacity of the wood fuel. Consequently, it poses more collection of woodfuels from the surrounding forests leading to deforestation. Chittagong Hill Tracts in Bangladesh is inhabited by 11 ethnic communities fostering their distinct cultural practices. Among them *Chakma* composes of the major group in the region. Their traditional land use pattern coincides with 'shifting cultivation' and energy use pattern like cooking is mostly dependent on wood energy sourced from the surrounding natural forests. Their traditional cooking system is acting as the two-way environmental deterioration, i.e., deforestation and greenhouse gas emission. An optimum efficiency of wood fuel can reduce the emission of greenhouse gases to the atmosphere as well as can reduce the deforestation in the natural forests.

The study was carried out to assess the total wood fuel consumption in relation to the family-size, family-income, and amount cooked and burning time as well as to assess the emission of greenhouse gases from the traditional cooking stoves of the *Chakma* community in the Chittagong Hill Tracts. A stratified simple random sampling was used to carry out the study. The study revealed that wood fuel consumption was significantly affected with the change in family-size, family-income, amount cooked and burning time. The study revealed that an average of 2.71 ton of wood fuel was consumed per family annually and due to the burning of this amount of wood fuel 1.22 ton of total carbon, 4.47 ton of CO_2, 0.0195 ton of CH_4, 0.1705 ton of CO, 0.0001 ton of N_2O, 0.0048 ton of NO_x and 0.0032 ton of NO was emitted per family per year. The study showed that 97% families used wood fuel only and 2% families used biogas along with wood fuel while another 1% families used LPG along with wood fuel. Almost all the women engaged in cooking reported that they suffer from minor health hazards like headache, eye-irritation etc. due to smoke emission and among them, 63% was eager to accept the improved**.**

3.*9 David Pannell, University of Western Australia* - **Socioeconomic issues in achieving uptake of bioenergy crops into established agricultural systems**

Abstract

Development of new industries based on bioenergy crops requires us to be able to anticipate decisions by landholders to supply feedstock. The process of adoption of new technologies and new practices by farmers has been studied intensively, and, though complex and multi-faceted, it is well understood. The adoption process is fundamentally one of learning over time. Adoption depends on a range of personal, social, cultural and economic factors, as well as on characteristics of the innovation itself. Adoption occurs when the landholder perceives that the innovation in question will enhance the achievement of their personal goals. Small scale trialling plays an important role in the learning process. Economic evaluation is central to understanding and anticipating adoption. The economics of bioenergy crops can be complex because of their interaction with the rest of the farming system. Examples from Western Australia illustrate that complexity and provide lessons about the conduct of economic analyses.

POSTER

Hitofumi Abe[1], Akio Katayama[2], Sat Samy[3] and Pauline F. Grierson[1], [1]Ecosystem Research Group, School of Plant Biology, The University of Western Australia; [2]Nippon Koei Co.,Ltd; [3]Ministry of Industry, Mines and Energy, Royal Government of Cambodia - **The Potentials of Rural Electrification by Biomass Energy in Cambodia**

Abstract

There are 13,914 villages in Cambodia and only 2,588 villages (19%) are electrified. The other 11,326 villages (81%) are yet to be electrified. Royal Government of Cambodia targets 100% rural electrification by 2020, mainly utilising renewable energy. Here we examine the potential of biomass electrification in Cambodia.

Among those un-electrified villages, we excluded 753 villages as under planned grid extension area or high potential area for near future grid extension and 137 villages as appropriate for micro-hydro electrification. Then we screened remaining villages with following two criteria. One is TV diffusion level > 10%. This indicates battery diffusion level and the ability to pay for electricity. The other one is grassland and shrubland area per household > 0.02 ha. This indicates the sufficient land availability for energy tree planting. As the results above, we conclude 6,328 villages (45% of overall villages and 56% of un-electrified villages) are potentially appropriate for biomass electrification.

In addition to tree planting, agricultural residues such as rice husk (1 million t/year) and old rubber trees (25,000 t/year) are potential biomass resource for electricity generation. However these are generally well utilised as local energy sources and the information for the availability is not sufficient therefore we do not consider agricultural residues as biomass fuel source for electricity generation at a national level. But they should be fully surveyed and utilised for electricity generation at village planning level.

The capital cost of biomass mini grid is roughly $430/household. This is 43% higher than diesel mini grid ($300/household). Although capital cost is higher in biomass system than diesel system, the cost for unit power generation is possibly much lower with biomass system depending on the plant capacity factor as fuel costs ($0.03/kWh) are much lower than diesel ($0.18/kWh). Rural electrification by biomass energy in Cambodia is thus a viable scheme in terms of both resource availability and economical factors.

Session 4. Efficiency and Economics of Forest Energy Operations

4.1 Jianbang Gan[1] and C.T. Smith[2], [1]Texas A&M University, USA and [2]University of Toronto, Canada – **Co-benefits of utilizing logging residues for bioenergy production: the case for Eastern Texas**

Abstract

This study evaluates the co-benefits associated with the utilization of logging residues for bioenergy production in the eastern Texas. The benefits to be evaluated include the value of CO_2 emissions displaced due to substituting logging residues for coal in electricity production, reductions in site preparation costs during stand regeneration, and new jobs and income generated in the local communities. According to the 2004 Forest Inventory Analysis data, annual average logging residues in Texas are estimated at 1.3 million dry tonnes. Assuming a 70% biomass procurement rate, these logging residues, if used for electricity production, would displace about 2.44 million tonnes of CO_2 (1.6% of CO_2 emissions from coal-fueled electricity production in the state), valuing about $2.6 million at the current CO_2 price traded at the Chicago Climate Exchange. In addition, removing logging residues would save $200-250/ha in site preparation costs. The community impacts of procuring logging residues for bioenergy production will be estimated via Input-Output modeling. These results are expected to provide new insights into the cost-competitiveness of forest biomass in bioenergy production.

4.2 Toshio Nitami[1], Yutaka Tate[2], Rin Sakurai[1], Teruhisa Ohno[3], [1]University of Tokyo, [2]Rengo Co. Ltd., [3]Chichibu City, Japan – **Demand for biofuels at regional energy use and need for road system in mountainous area**

Abstract

The amount of forest biomass available was discussed when forest roads are opened at mountainous area. Harvesting costs were estimated along with forest roads establish levels. Biofuels were expected to be used at public service establishments. Two scenarios, centralized and scattered, were designed for biofuels utilization and three scenarios, present state, expand to 100m decrease for logging distance and establish densely to log shorter than 100m, were designed for forest roads establishment. Harvesting operation systems were assumed following regional common techniques, such as vehicle ground system, tower yarder, swing yarder and cable yarder. At the present state, 60 thousands m^3 meter is available at centralized utilization system and 80 thousands m^3 at scattered one at harvesting cost 56 US$. Those came to 80 and 100 when roads expanded to 100m decrease for logging distance, respectively. And those came to 90 and 120 when roads were established densely to log shorter than 100m at every site.

Keywords; forest biomass, biofuels, harvesting, forest roads, mountainous terrain

4.3 Göran Hedman, Naturbränslen, Sweden – **Technology and economics of forest fuel production**

Abstract

Naturbränsles main operational area is the middle part of Sweden. During this year our sales will amount to 3,2 TWh forestfuel to heating plants and pelletproducing industries.

Our company delivers by-products such as sawdust and bark, mostly from our owner's sawmills. We produce wood-chips from forest residuals and from stem wood, not valid to industrial purposes.

Biofuel – nearly the same price during 25 years
Wood fuel in Sweden is mainly produced in forests dominated by conifers, spruce and pine.
A main part of our sales is based on production of forestfuel. The raw-material is normally branches and twigs from clear cuttings, and the potential is still considerable.

Todays marketprice on biofuel in Sweden is just around 15 % price higher then 25 years ago, considering inflation the price is actually much lower now. We have managed to handle this through different improvements. For example a chipper, operating after clearcuttings and at road-sites, nowadays produces up to 150 000 m3 loose/year, twenty years ago a common level was
15-30 000 m3 loose/year.

We have also succeed to increase the average energy-content in forestfuel. This by letting the raw-material to dry in piles during the summer, and wait with the chipping until the winterperiod.

The demand for biofuel will surely continue to increase, and there are still possibilites to improve the methods for production, and transportation. This is important since our plan is to increase our production of forestfuel with 30 % during the following two years.

In a couple of years we believe in new technology and systems for "energy-harvesting" in thinnings.
This together with a bit higher marketprice on biofuel will make it possible to replace more fossilfuel.

4.4 Rolf Björheden, Växjö University, Sweden - **The effects on the energy sector of the storm felling in south Sweden**

Abstract

On the evening of January 8, 2005, the already strong wind increased all over Sweden. In south Sweden, it reached hurricane levels. On the morning of January 9 the tally of destruction could start. Houses and structures had been severely hit in the core areas of the storm, many roads were blocked and large areas inaccessible except by helicopter, electricity and telecommunications were even more shambolic.

In the great work to mend, restore and parry the after-effects of the storm, a special focus has been placed on the forest sector. The total windthrown volume – 70-80 million cubic meters - equals a ‘normal’ Swedish felling, and a gross value to the Swedish economy of some 25 billion Euro. For the forest sector in south Sweden logging work alone will last for at least a couple of years and the market for roundwood will be severely strained. For some individual forest owners, the economic effects of the storm can be described as disastrous.

It follows that salvaging of maximum value is the emphasis of the restoration work and public support following the storm. The severely hit forest owners will thus be able to retrieve at least a fraction of the value their forests represented on the evening before the storm. The forest industry in south Sweden, especially the sawmills, may thanks to quality preserving measures during storage use most of the most valuable timber for the years to come. Hereby, the risk of painful capacity adjustments is decreased and the export income is protected.

4.5 Brad Stennes and Bill White, Canadian Forest Service – **The bioenergy potential of British Columbia's mountain pine beetle damaged forests [presented by Jim Richardson]**

Abstract

The Mountain Pine Beetle (*Dendroctonus ponderosae*), a bark beetle native to western North America, has caused very significant damage to mature pine stands in central British Columbia during an outbreak which began in 1999. Up to 2004, 9 million ha had been affected and 240 million m^3 of timber had been killed, three times the annual harvest in the entire Province. It is expected that 100 million m^3 will be salvaged over the next 4 years. The balance of dead timber may provide opportunities for bioenergy. British Columbia presently has about 650 MW of power generating capacity based on woody biomass, almost all of it internally used by pulp and paper mills, but there is a policy that 50% of all new electrical generation shall be from "green sources". Biomass feedstock resulting from beetle kill will be costly and temporary. The presentation assesses the economic feasibility of biomass energy production from beetle killed timber, taking into account potential carbon credits. Potential solutions that could optimize the bioenergy opportunities are suggested.

4.6 Robert N. Coulson[1], Guy L. Curry[1], Maria D. Tchakerian[1], Jianbang Gan[1] and C.T. Smith[2],
[1]Texas A&M University, USA and [2]University of Toronto, Canada – **Utilization of Plant Biomass Generated From Southern Pine Beetle Outbreaks**

Abstract

The southern pine beetle (SPB) (*Dendroctonus frontalis* Zimmermann) is the most significant mortality agent affecting yellow pines in the southern US. Outbreaks of the SPB vary in their intensity, duration and cycle within the Southern region. Typically, when an outbreak occurs, local wood products markets become swamped and traditional utilization pathways (e.g., saw logs and cord wood) close because of lack of demand. Consequently, the resource is abandoned and the economic value of the commodity is lost. The goal of this paper is to evaluate various methods for the utilization of SPB-generated plant biomass. The specific objectives are: (1) to define the spatial and temporal distribution, type, and quantity of SPB-generated plant biomass associated with different outbreak scenarios, (2) to present a linear programming model that defines utilization pathways for SPB-generated plant biomass, and (3) to examine the economic feasibility of the various utilization pathways of SPB generated plant biomass. Inventory data on losses resulting from herbivory by SPB were assembled for three National Forests in the southern US: the Homochitto (Mississippi), Kitsatchie (Louisiana), and Bankhead (Alabama). Each of these forests had an extended SPB outbreak lasting three to five years. Data were extracted and summarized from the SPBIS (Southern Pine Beetle Information System) database, maintained by the USDA Forest Service. These data provided a record of the quantity and flow of SPB-generated plant biomass throughout the course of each outbreak. The production system model we developed identifies various pathways for utilization of SPB-generated plant biomass. The model incorporates variables such as flow (quantity) of biomass, quality of biomass, harvesting practices, transportation options, and end products. The annual quantity of SPB-generated plant biomass in particular (and disturbance-generated plant biomass from all sources in general) is substantial and the approach we present provides a means for evaluating the economic feasibility for utilization.