



An Australian Government Initiative



Participation in IEA Bioenergy *Short Rotation Crops for Bioenergy Systems* Task

**A report for the RIRDC/Land & Water
Australia/FWPRDC/MDBC
Joint Venture Agroforestry Program**

by Stephen Schuck

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Foreword

A consortium of Australian organisations, convened by Bioenergy Australia, a government-industry forum fostering the development of bioenergy as a future source of sustainable energy, has been participating in the International Energy Agency's Bioenergy program Task entitled 'Short Rotation Crops for Bioenergy Systems'. This participation has been made possible through the funding provided by the Joint Venture Agroforestry Program (JVAP) and financial and other contributions from the participant organisations.

This project has led to close collaboration with leading international experts developing short rotation crops for energy and other value-added co-products and co-values. It has allowed interaction and joint work on a variety of technical and socio-economic issues related to the growing of energy crops.

This participation in the IEA Bioenergy Task on 'Short Rotation Crops for Bioenergy Systems' has included participation at annual international workshops, including field trips, and the production and dissemination of a number of documents noted in this report.

A key purpose of this report is to publicise this Australian participation in this Task, and to provide an overview of, and access to reports and knowledge obtained during this IEA Bioenergy Task participation.

This project was funded by the Joint Venture Agroforestry Program (JVAP), which is supported by three R&D Corporations — Rural Industries Research and Development Corporation (RIRDC), Land & Water Australia, and Forest and Wood Products Research and Development Corporation (FWPRDC), together with the Murray-Darling Basin Commission (MDBC). These agencies are funded principally by the Australian Government.

This report, a new addition to RIRDC's diverse range of over 1000 research publications, forms part of our Agroforestry and Farm Forestry R&D program, which aims to integrate sustainable and productive agroforestry within Australian farming systems.

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Simon Hearn

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The author would like to acknowledge the contributions to this project from the members of Bioenergy Australia, a government-industry alliance fostering the development of bioenergy in Australia (see www.bioenergyaustralia.org). In particular, Bioenergy Australia has formed a subgroup to participate in this project, who have provided financial assistance to enable representation at international meetings of IEA Bioenergy Task 30 *Short Rotation Crops for Bioenergy Systems*. Special thanks are due to Mr Don McGuire of Forestry SA who has acted as National Team Leader for Task 30, and who has greatly assisted with the flow of technical information through Bioenergy Australia during this project.

Contents

Foreword	<i>iii</i>
Acknowledgements	<i>iv</i>
Executive Summary	<i>vi</i>
1. Introduction	1
2. Objectives.....	3
3. Methodology	4
4. Results of participation in IEA Bioenergy Task 30	5
5. Implications.....	7
6. Recommendations	8
7. Appendix 1 - Publications	9
8. Appendix 2 - Prospects for BioEnergy from Short-Rotation Crops in Australia -	12

Executive Summary

The Joint Venture Agroforestry Program (JVAP) has supported and made possible Australian participation in the International Energy Agency's (IEA) Bioenergy Task 30, entitled 'Short Rotation Crops for Bioenergy Systems' for 2001-2003. Task 30 is one of twelve Tasks within the IEA Bioenergy international collaborative agreement which involves some 19 countries plus the European Commission. IEA Bioenergy links international researchers from the participant countries (mainly from the OECD), who conduct a joint work program endorsed by the Executive Committee of IEA Bioenergy. These Tasks generally run on a three year cycle, the most recent cycle being from January 2001-December 2003.

Australian participation in IEA Bioenergy has been through Bioenergy Australia (www.bioenergyaustralia.org), an alliance of some 43 government and private sector organisations. Bioenergy Australia participates in five Tasks, including Task 30 'Short Rotation Crops for Bioenergy Systems'. A sub-group of experts from Bioenergy Australia has been formed for this participation, and has been headed at a technical level by a National Team Leader, who is charged with having representation at the international meetings, providing contributions to the technical program and disseminating information from these meetings back in Australia. Participation is through collaborative RD&D work, conducted in the various participant countries in this Task. Task 30 has been headed by Professor Theo Verwijst, Professor of Short Rotation Forestry at the Swedish University of Agricultural Sciences.

Results of this collaborate work are presented at workshops which are invariably accompanied by field trips to illustrate work outcomes. Reporting of the Task's activities is via Proceedings issued after each major meeting, and also through occasional technical papers. Task 30 maintains a web site on its work at www.shortrotationcrops.com, which contains the Task outputs and other information.

This report provides the context for participation in Task 30, main work areas and activities, meetings which have taken place, the information which has been obtained from participation, and the various reports that have been produced and how to access these reports.

1. Introduction

The emergence of global warming as a major international issue has led to a heightened interest in a range of renewable energy sources and technologies, including bioenergy. As part of its response to the Kyoto Protocol, Australia has legislated that an additional two percent of renewable electricity must be sourced by wholesale purchasers and large electricity users in Australia by 2010 and held at this level until 2020. To provide certainty for industry, this level has been set at 9,500 GWh per annum, phased in from April 2001 until 2010 and held at this level until 2020. This amount of electricity is about twice the output of the Snowy Mountains hydro-electricity scheme. This Mandatory Renewable Energy Target (MRET) is legislated through the Renewable Energy (Electricity) Act 2000 and the Renewable Energy (Electricity) Regulation 2001, and commenced operation from 1 April 2001. The MRET legislation addresses various sources of biomass and generally permits wastes from plantation and forestry operations, and purpose grown energy crops.

In the lead up to the enactment of the MRET, studies commissioned by the Federal Government and others identified that a significant proportion of this new renewable electricity capacity is likely to be provided by biomass, including from plantations and energy crops, the scope of this project. These studies have also suggested that new investment in renewable energy sources for meeting this government mandated target will be approximately \$3 billion.

Other drivers exist for bioenergy, besides the mandated renewable energy target. A national Green Power market has been developed in Australia, where customers are invited to pay a premium for power with certain environmental credentials. Sustainably grown biomass from agroforestry would qualify as a feedstock for this premium niche market. In addition the NSW Government has a greenhouse gas benchmark scheme for electricity retailers operating in that state, which operates through the trading and surrender of NGACs (NSW Greenhouse Gas Abatement Certificates). Again renewable energy sources, including energy crops are compliant forms of renewable energy under this scheme.

Bioenergy has also aroused interest for a range of other benefits as well. Short rotation energy crops would have Landcare benefits for salinity and erosion control, add to animal habitat and hence biodiversity, and could be a feedstock for a range of new industries besides energy. Bioenergy tends to be a local, rural and regional energy source, with the feedstock converted to energy close to the source of production. A typical 20 MW bioenergy power plant would require approximately 200,000 tonnes per year of biomass fuel, providing the prospect of industry development and permanent job creation in rural areas.

This interest in bioenergy, including a focus on farm forestry and energy crops has seen the Joint Venture Agroforestry Program (JVAP), managed by the Rural Industries Research and Development Corporation (RIRDC), commissioning studies such as the 'Wood for Alcohol Fuels' and 'Biomass Energy Production in Australia – status, cost and opportunities for major technologies'.

These opportunities and heightened interest in biomass energy led to the formation of Bioenergy Australia (formerly called the Biomass Taskforce) in mid 1997 by a core group of Federal Government organisations, including RIRDC. At the inception of Bioenergy Australia, participation in IEA (International Energy Agency) Bioenergy was envisaged as a means of leveraging information from countries that have been implementing biomass energy for several years, to accelerate the uptake in Australia.

IEA Bioenergy is an international collaborative agreement on bioenergy, and is one of several Implementing Agreements operated under the IEA umbrella. IEA Bioenergy was originally established as the Forestry Energy Agreement in 1978 to foster international co-operation and information exchange between national bioenergy programs. Seventeen Organisation for Economic

Co-operation and Development (OECD) countries, the European Commission, and more recently non-OECD countries (e.g. Brazil and Croatia) currently participate in IEA Bioenergy. IEA Bioenergy operates by means of a number of focused Tasks co-ordinated by an Executive Committee, whose secretariat has been based in New Zealand. There were twelve Tasks for the period 2001-2003. These Tasks have been:

- Solid biomass fuels standardisation and classification
- Socio-economic aspects of bioenergy systems
- Short rotation crops (SRC) for bioenergy systems
- Conventional forestry systems for sustainable production of bioenergy
- Biomass combustion and co-firing
- Thermal gasification of biomass
- Pyrolysis of biomass
- Techno-economic assessments for bioenergy applications
- Energy from integrated solid waste management systems
- Energy from biogas and landfill gas
- Greenhouse gas balances of biomass and bioenergy systems
- Liquid biofuels

On the basis of the perceived benefits of participation in IEA Bioenergy, in 1998 Bioenergy Australia assessed the merits of participation in IEA Bioenergy and decided to proceed, subject to funding being available. A successful application was submitted to the Joint Venture Agroforestry Program for funding assistance to allow a consortium of organisations to participate in the earlier IEA Bioenergy Task 17 *Short Rotation Crops for Bioenergy* for 1999 and 2000 of Task. In addition this participation provided representation on the Executive Committee of IEA Bioenergy which oversees the entire IEA Bioenergy program. This participation was extended to the new Task 30 from 2001-2003, the subject of this report.

An industry consortium consisting of Bioenergy Australia members: Department of Conservation and Land Management of WA (CALM), Forestry SA, Victoria's Forest Science Centre (Natural Resources and Environment (NRE)/Department of Sustainability and Environment), Tarong Energy, Queensland Forestry Research Institute (QFRI), Southern Pacific Petroleum, Enecon Pty Ltd, MBAC Consulting Pty Ltd, BioEnergy Australia Limited and Bureau of Rural Sciences (BRS) have participated in Task 30 as a subgroup of Bioenergy Australia from 2001-2003.

Nine countries participated in Task 30 from 2001-2003. They have been: Australia, Brazil, Canada, Croatia, Denmark, New Zealand, the United Kingdom, the United States of America, and Sweden.

2. Objectives

The objective of participation in the Short Rotation Crops for Bioenergy Systems Task of IEA Bioenergy has been to allow Australia to gain access to the latest information and to network with the world's foremost authorities in the area of short rotation crops for bioenergy. Specific objectives have been to source first hand information on world's best practice in planting design, harvesting and equipment design for harvesting and handling, and improving the economics of short rotation forestry for bioenergy. The objective has also been to provide a focus for short rotation forestry in Australia in the form of the participation consortium drawn from the Bioenergy Australia membership and beyond.

In addition, participation in this Task was expected to, and has provided Australia with access to other IEA Bioenergy Task information. For instance the annual meeting held in November 2002 was a combined meeting with Task 31, 'Conventional Forestry Systems for the Production of Sustainable Bioenergy'.

Organisations within Australia are already formulating large scale short rotation forestry projects and our participation has the objective to provide valuable information towards this development.

Participation in IEA Bioenergy Task 30 provides an impetus to the development of biomass energy in Australia with the multiple benefits of providing economic uses for residues (where short rotation crops are used for wax, oil and gum production), salinity control, industry and job creation in rural areas, and providing a source of renewable energy to help meet national targets and international obligations.

3. Methodology

Participation in Task 30 of IEA bioenergy was conducted by forming a national group convened by the Bioenergy Australia Manager, Dr Stephen Schuck with representatives from Department of Conservation and Land Management of WA (CALM), Forestry SA, Victoria's Forest Science Centre (NRE/Department of Sustainability and Environment), Tarong Energy, QFRI, Southern Pacific Petroleum, Enecon Pty Ltd, MBAC Consulting Pty Ltd, BioEnergy Australia Limited and BRS.

Funds management was handled by Stephen Schuck and Associates Pty Ltd on behalf of Bioenergy Australia. International Task meetings were attended by an appropriate technical expert, decided by consensus of the group, led by the National Team Leader, Don McGuire of Forestry SA. Information in the form of Task reports, Task meeting reports, formal Proceedings of meetings was disseminated back to the participating group, and at Bioenergy Australia quarterly meetings and the annual Bioenergy Australia conference. Information on participation in IEA Bioenergy and Task 30 was also disseminated in articles in the Bioenergy Australia newsletters, and on the web page of Bioenergy Australia (www.bioenergyaustralia.org). An end-of-task seminar was held as part of the Bioenergy Australia 2003 conference on 9 December 2003 in Sydney. This brought together the Australian stakeholders and participants, as well as several of the international Task participants. The Task Leader, Professor Theo Verwijst of Sweden also provided at this conference the keynote address on this Task and on short rotation crops for bioenergy. These presentations were contained in the Proceedings of this conference.

Feedback on the work of the Task is also provided through the Task website, established as part of this project at www.shortrotationcrops.com. This web site also contains newsletters from the Task, as well as other technical information.

The Task Themes for 2001-2003 were:

- role of short rotation crops in improving water quality
- harvesting and fuel supply logistics
- nutrients (including water use efficiency)
- disease
- co-products including externalities.

The 'High Priority Areas' of the Task, reaffirmed at the 2002 annual meeting in Brazil have been:

- sustainable SRC-Systems: Biomass production and technical aspects
- sustainable SRC-Systems: Environmental and economic externalities
- full-scale implementation of SRC-systems: Assessment of technical and non-technical barriers
- the use of Policy instruments - incentives, regulations, legislation to boost bioenergy, and assessment of their effectiveness
- systematic SRC-knowledge transfer: (Development of web-based communication, compilation and dispersal of SRC-knowledge).

The work program of the Task has focused on:

- integration of production and environmental functions
- barriers to large-scale implementation
- pest and disease
- environmental consequences of short rotation biomass production and
- information package and dissemination.

4. Results of participation in IEA Bioenergy Task 30

In the three year period 2001-2003 of participation in Task 30 *Short Rotation Crops for Bioenergy Systems* the following broad objectives have been fulfilled:

- access to up to date information on biomass crop production systems and methods
- strengthened contact with international researchers and developers of short rotation energy systems
- development of new markets for agroforestry and energy crops
- stimulation of the bioenergy industry within Australia (a potentially important contributor to reducing domestic greenhouse emissions)
- contribution to the development of new rural industries and jobs
- participation on the Executive Committee of IEA Bioenergy providing access to information and developments from other Task groups.

Of note, a consortium including Bioenergy Australia members CALM WA, Western Power Corporation, Oil Mallee Company and Enecon Pty Ltd have made good progress in developing the Narrogin, WA Integrated Wood Processing plant based on short rotation oil mallee alley crops. This demonstration plant has now been constructed, with commissioning and commercial operation pending.

Outputs from the Task primarily comprise the Proceedings from annual Task meetings, as well as occasional technical papers.

Meetings in this triennium have been held in Denmark (attended by Chris Borough of MBAC Consulting), Brazil (attended by Dr Tom Baker of the Department of Sustainability and Environment (DSE) of Victoria and Don McGuire of Forestry SA), and New Zealand (attended by Don McGuire and Rick Giles of CALM). The Brazil Proceedings are to be published in *Biomass and Bioenergy* (Pergamon Press), while hard copies of the NZ and Denmark Proceedings have been provided to RIRDC.

Chris Borough, then of BioEnergy Australia Limited, attended the 2001 Task meeting at Viborg, Denmark, in September 2001. The Viborg meeting included technical visits to Hornum (Miscanthus plantings and short rotation willow plantings), a farm at Ny Aarva to inspect 30 ha of willow plantings and wood pelletising, the Lokken 8 MW community heating plant fuelled mainly on chipped willow, the Hvidsted Energy Forest (Vibe Gro)/Border Biofuels farms, the Langholt potato flour processing plant where 25 ha of willow is used for filtering the effluent stream. Of interest was the use of live willow stems with rockwool to form highway noise barriers. The technical workshop itself provided a number of presentations and discussions over two days on short rotation energy crops. Future work programs and arrangements were also discussed.

Don McGuire of Forestry SA and Tom Baker of the Victoria Department of Sustainability and Environment attended the 2002 Task meeting 28 October - 1 November 2002 at Belo Horizonte in Brazil. This was a combined meeting with Task 31 (as noted above). The theme of this meeting was 'Sustainable Bioenergy Production Systems: Environmental, Operational and Social Implications'. The annual meeting included technical tours to V&M Florestal at Paraopeba to visit eucalyptus plantations, charcoal and tar production site and a research laboratory at CAPEF (the research centre of V&M), a visit to Aracruz Cellulose to view short rotation plantations and their tree nursery. Aracruz Cellulose is a world leader in eucalypt pulp, producing 2 million tonnes of pulp in 2002.

Don McGuire also provided to this meeting a report entitled 'Prospects for BioEnergy from Short-Rotation Crops in Australia - Update 2002' by Chris Borough. This report is provided for reference in Appendix 2.

The 2003 annual IEA Bioenergy Task 30 meeting was held at Mount Maunganui, Tauranga, in New Zealand from 1-5 December 2004. This was attended by Don McGuire of Forestry SA, the National Team Leader for Australia in this Task, and by Rick Giles of CALM WA, who contributed to the annual meeting. The Proceedings from the New Zealand Task 30 meeting, which had the theme 'The role of short rotation crops in the energy market' have been produced in hardcopy (provided to RIRDC). The Proceedings of the meeting are 283 pages plus 26 pages of notes from the field tour associated with the meeting to four locations; two year old Eucalypt plantation; Kinleith co-generation plant; wood waste landfill phytoremediation, Kopu; and subsurface drip irrigation trial. The main meeting consisted of seven sessions over two days, with some forty presentations. Session titles included: Setting the Scene for Short Rotation Crops (SRC), SRC Market Economics, Crop Productivity, SRC Conversion, SRC Multiple Use/Sustainability Opportunities, SRC Policy, and Bringing It All Together. Don McGuire co-presented a 21 page paper "A Review of Short Rotation Crops for Environmental and Economic Externalities- Australian Implications, and also a paper "Australasian Experiences with Land Treatment Schemes and Irrigated Forestry", while Rick Giles co-presented a paper "Developing a Biomass Supply Chain for New Australian Crops". The meeting program is available on the Task web page, www.shortrotationcrops.com.

A development in Task 30 has been the development of a substantial web page at URL: www.shortrotationcrops.com . A colour newsletter has also been developed by the Task. Three newsletters are downloadable from this website. The details of the web addresses for these newsletters are contained in Appendix 1.

5. Implications

The requirement for low carbon dioxide emitting energy technologies in a future carbon constrained energy economy will require the adoption of renewable energy sources and technologies. Biomass energy technology is essentially carbon dioxide neutral and is likely to play an ever increasing role in the future energy mix. A recent study entitled 'Clean energy future for Australia', commissioned by a consortium of organisations, including Bioenergy Australia and the WWF found that a fifty percent reduction in carbon dioxide emissions from energy supply by 2040 could be met by various alternative energy technologies, including natural gas cogeneration, energy efficiency and renewable energy. Biomass was found to be the largest contributor to the energy mix, providing 28 percent of Australia's stationary energy supply. Although this study concentrated on agricultural and forestry residues, it was recognised that energy crop biomass would be an important contributor to the future energy generation mix.

Participation in this project has provided Australia with a sound basis for future developments in this area. It now remains to build on this knowledge through Bioenergy Australia's ongoing participation in this Task to consolidate and expand on this foundation.

6. Recommendations

Short rotation crops for bioenergy is seen to be an important future area for Australia, not only for the direct production of energy, but also for the co-values and co-products associated with such developments. These include the generation of Renewable Energy Certificates under the Mandatory Renewable Energy Target (MRET), NSW Greenhouse Abatement Certificate (NGAC) under NSW legislations, Green Power credits, as well as salinity mitigation, erosion control, adding to animal habitat and hence biodiversity, and rural economic development and local employment.

As such it is recommended that attention continue to be focused on the development of short rotation energy crops for energy and other value-added products and values.

7. Appendix 1 - Publications

Newsletters from Task 30

Three Task 30 newsletters are downloadable from as follows:

- Newsletter No. 1, April 2002 [265 kB PDF]
<http://www.shortrotationcrops.com/PDFs/Task30News1.pdf>
- Newsletter No. 2, April 2003 [1733 kB PDF]
<http://www.shortrotationcrops.com/PDFs/Task30News2.pdf>
- Newsletter No. 3, October 2003 [1957 kB PDF]
<http://www.shortrotationcrops.com/PDFs/Task30News3.pdf>

Proceedings from the Task 30 meeting held in Denmark, 22-25 September 2001, published in the 'DIAS report – Plant Production no. 86', Danish Institute of Agricultural Sciences, Ministry of Food, Agriculture and Fisheries, January 2003.

These reports are available through the website of the Task: www.shortrotationcrops.com

- [Combined Production of Biomass for Energy and Clean Drinking Water](#), Uffe Jorgensen [914 KB PDF]
- [Combustion of Miscanthus and other Biofuels in a Full-Scale CHP Plant](#), Las D. Fenger [169 KB PDF]
- [Energy Crops for Agriculture - Benefits or Constraints?](#) Irene A. Wiborg, [66 KB PDF]
- [Greenhouse Gas Emission from Agriculture and the Possible Mitigation by Production of Energy Crops](#), Jorgen E. Olesen [131 KB PDF]
- [Harvesting and Handling of Miscanthus](#), Erik Flojgaard Kristensen [173 KB PDF]
- [How is Life if you try to Live from Developing SRC in Denmark?](#), Vibe Gro and Damian Culshaw [302 KB PDF]
- [Securing of Supply in Short and Longer Term of Wood and Straw](#), Gert Schultz [109 KB PDF]
- [The Danish Energy Crop Research and Development Project](#), Morten Gylling, [134 KB PDF]

Proceedings from Brazil meeting - theme "Sustainable Bioenergy Production Systems: Environmental, Operational and Social Implications". The Proceedings of this meeting are to be published in *Biomass and Bioenergy*. The papers are available through the Task 30 website.

- [Development of short rotation willow coppice systems for environmental purposes in Sweden](#), Jaconette Mirck [614 kB PDF]

- Linking Phytoremediation Applications with Bioenergy, Dr Louis Licht [4990 kB PDF]
- Renewable energy in organic farming, Uffe Jorgensen [466 kB PDF]
- Short Rotation Crops for Bioenergy Systems, Verqijst [42 kB pdf]
- The interaction of tree stocking, soil and foliar nutrition and climate on stand productivity of selected eucalypt species in New Zealand, Ian Nicholas [209 kB PDF]
- Tree and Stand Biomass Estimation Using a Tariff Approach, Dan McGuire [1403 kB pdf]

Proceeding of the IEA Bioenergy Task 30 Conference ‘Short Rotation Crops for Bioenergy’. Mt Maunganui, New Zealand. 1-4 December 2003. Nicholas, I.D. (Compiler)

- Short Rotation Crops in the World, Professor Theo Verwijst [143 KB PDF]
- A review of Short Rotation Crops (SRC) environmental and economic externalities - Australasian implications, I.D. Nicholas and D.O. McGuire [206 KB PDF]
- Bioenergy in New Zealand - The way forward, Peter Denstead [145 KB PDF]
- SRC in New Zealand: Policies and research - a brief overview, Ian Nicholas [247 KB PDF]
- The place for bioenergy in the New Zealand energy market, Brian Cox [300 KB PDF]
- The cost relativity of New Zealand biomass heating fuel systems, Ralph E.H. Sims and Piero Venturi [194 KB PDF]
- Markets for Short Rotation Crops - European experience, Eddie Johansson [330 KB PDF]
- Markets for Short Rotation Crops - the American experience, Jake Eaton [98 KB PDF]
- Eucalypt SRC - sensitivity analysis of growing costs in New Zealand, Ian Nicholas [145 KB PDF]
- Market values for growing eucalypts in the Central North Island - chips and solid wood, K. Molony, S. Kincheff and B. Poole [72 KB PDF]
- Delivering on the energy coppice promise - A UK experience, Charlotte Bruton and Keith Richards [221 KB PDF]
- Sustainability of willow SRF during later cutting cycles, Nils-Erik Nordh [136 KB PDF]
- The Swedish Enköping CHP plant, Eddie Johansson [309 KB PDF]
- Residues after eucalypt harvesting in New Zealand, P. Hall and I.D. Nicholas [155 KB PDF]
- Experimental Short Rotation Crops in Croatia, Davorin Kajba and Sasa Bogdan [107 KB PDF]
- Harvest techniques in Europe, Nils-Erik Nordh and Ioannis Dimitriou [120 KB PDF]

- [Developing a biomass supply chain for new Australian crops](#), Mr R.C. Giles and Dr H.D. Harris [320 KB PDF]
- [Transport economics for short rotation coppice](#), Ralph E.H. Sims [416 KB PDF]
- [SRC eucalypt combustion](#), Anthony H. Clemens and Desmond Gong [140 KB PDF]
- [Pellets - processing into a pellet fuel](#), Dr Per Nielsen and George Estcourt [126 KB PDF]
- [Co-firing opportunities - knowing what to expect](#), Anthony H. Clemens and Desmond Gong [138 KB PDF]
- [Combustion economics](#), Dave Bennett [153 KB PDF]
- [Utilization of short rotation woody crops in the western USA](#), Jake Eaton [296 KB PDF]
- [Phase farming with trees: An option for dryland salinity control and feedstock for bioenergy](#), N. Robinson, R.J. Harper and A.T. Stilwell [233 KB PDF]
- [Australasian experiences with land treatment schemes and irrigated forestry](#), Don McGuire, Ian Nicholas and Tom Baker [159 KB PDF]
- [Wastewater phytoremediation treatment systems in Sweden using short rotation willow coppice](#), Ioannis Dimitriou and Par Aronsson [106 KB PDF]
- [Using poplars and willows for Phytoremediation in the USA](#), J.G. Isebrands [105 KB PDF]
- [Nitrogen uptake in New Zealand Short Rotation Crops](#), Ian Nicholas [117 KB PDF]
- [Interplanting for bioenergy and riparian restoration in the southeastern USA](#), Jon Stanturf, Emile Gardiner and Stephen Schoenholtz [148 KB PDF]
- [Biomass production and other ecological processes in rehabilitated riparian zones: 18 years of results from Southern Ontario, Canada](#), M. Gordon, M.E. Oelbermann, N.K. Kaushik and N.V. Thevathasan [88 KB PDF]
- [SRC for carbon sequestration](#), Adele Culvert [223 KB PDF]
- [Land assessment to integrate trees with agriculture for biomass production, carbon sequestration and salinity control](#), R.J. Harper, K.R.J. Smettem and R.J. Gilkes [126 KB PDF]
- [Industrial SRC policy](#), John Gifford and Brian Cox [104 KB PDF]
- [Certification for short rotation fast-wood forestry - lessons from the New Zealand experience](#), Chris Goulding and Errol Hay [178 KB PDF]
- [SRC with eucalypts in Brazil](#), Laercio Couto, Ian Nicholas, Marcelo Dias Muller and Daniel Camara Barcellos [95 KB PDF]

8. Appendix 2 - Prospects for BioEnergy from Short-Rotation Crops in Australia - Update 2002

Report Prepared by Chris Borough on behalf of the Australian National Short
Rotation Crops for Bioenergy Team

February 2002

Table of contents

	Page No.
1. INTRODUCTION.....	14
2. RESPONSE TO POLICY INITIATIVES.....	15
2.1 Green Power Schemes	15
2.2 Renewable Energy (Electricity) Act 2000.....	16
2.2.1 Key Regulations	16
2.2.2 Application of the Regulations.....	16
2.2.3 Comment on the Act	17
3. ACTIVITIES.....	18
3.1 Bioenergy from mallee eucalypts in Western Australia.....	18
3.1.1 Background	18
3.1.2 Perennial plant options	19
3.1.3 Narrogin Project	19
3.1.4 Esperance Project	19
3.2 Short rotation crops of <i>Casuarina</i> for bioenergy and charcoal	20
3.3 Forest and sawmill residues for bioenergy	20
3.3.1 Auspine bioenergy plant – Tarpeena, South Australia.....	20
3.3.2 Visy Pulp and Paper – Tumut, New South Wales.....	20
3.4 Wood fibre to supplement bagasse.....	21
3.5 Wastewater irrigated plantations for energy.....	21
4. CONCLUSION	22
References	23

1. INTRODUCTION

At the IEA Bioenergy Task 17 meeting in Auburn, Alabama, Baker *et al.* (1999) presented a review of the prospects for bioenergy from short rotation crops in Australia. At the IEA BioEnergy Task 30 meeting in Viborg in September 2001 it was agreed that each participating country provide an update of activities. This paper provides an update on the developments in Australia since 1999.

In November 1997, the Prime Minister issued a statement *Safeguarding the Future: Australia's response to Climate Change* that foreshadowed the government's intention to introduce mandatory targets for large electricity purchasers to source an increased proportion of their requirements from renewable sources. This policy initiative has stimulated substantial interest in all forms of renewable energy.

This statement was pre-dated by Electricity suppliers who commenced offering *Green Power* schemes whereby consumers may choose to purchase (at a premium) electricity generated from renewable sources. Green Power schemes are now available in six Australian States and Territories and run in parallel with Government mandated schemes.

On April 1st 2001, the Renewable Energy (Electricity) Act 2000 and associated Regulations were enacted. The Act sets mandatory targets for the generation of electricity from renewable resources. These targets increase annually for the next 10 years. Renewable Energy Certificates (RECs) are generated from the creation of renewable energy and the RECs are tradeable. This has effectively placed a premium on energy produced from renewable sources.

While short rotation energy cropping would be expected to be stimulated as a result of the Renewable Energy Act, there are clauses that preclude woody crops from being eligible and restrict the use of wood wastes substantially (Section 0). Australian legislators have effectively precluded the type of short rotation woody crop systems now used in Europe and North America.

Bioenergy Australia has become an important group representing the interests in bioenergy. Bioenergy Australia manages IEA Task 30 in Australia. The members of Task 30 are:

Organisation	Representative
Natural Resources and Environment (NRE) – Centre for Tree Technology	Tom Baker
Dept Conservation and Land Management	John Bartle
BioEnergy Australia Ltd	Chris Borough
ForestrySA	Don McGuire
Tarong Energy	Alex Driscoll
Southern Pacific Petroleum (SPP) / Central Pacific Minerals (CPM)	Stephen Grocott
Bureau Rural Sciences	Ray Spencer
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2. RESPONSE TO POLICY INITIATIVES

2.1. Green Power Schemes

Australian electricity suppliers have been quick to offer Green Power schemes; Green Power accredited products are now available to 96% of the Australian population through a range of electricity suppliers (Table 1).

Table 1: Green Power suppliers in Australia

State or Territory	Green Power Supplier
New South Wales	Country Energy Energy Australia Integral Energy
Victoria	Australian Inland Energy AGL Citipower Origin Energy Auspower (Yallourn Energy) TXU
Queensland	Pulse Energex Ergon Energy
Western Australia	NaturalPower (Western Power)
South Australia	AGL
Tasmania	Hydro Tasmania
Australian Capital Territory	ActewAGL Retail

The following sources of renewable energy are considered eligible:

- Solar power
- Wind
- Biomass
- Hydro-electric
- Geothermal
- Wave and tidal

Biomass includes energy crops and wood wastes. Wood sources from sustainably managed forestry plantations and clearing of specific noxious weeds are accepted; use of any materials from high-conservation value forest is not acceptable. The rules of eligibility differ from those of the Renewable Energy Act and, for example, allow short rotation woody crops.

Of the 31 projects using biomass (other than land-fill), 30 use bagasse (residue from processing sugar cane) as their source of bioenergy. Only one facility – Visy Paper at Tumut NSW uses wood waste from plantations and sawmills.

An estimated 60,000 customers used 470 GWh of Green Power in 2000-2001.

2.2. Renewable Energy (Electricity) Act 2000

The Australian Government has introduced a mandatory renewable energy target, which requires that an additional 9500 GWh of electricity (about 2% of total Australian output) will be required to be supplied from renewable energy sources by 2010 (Borough and Schuck 2001). This will raise the contribution that renewable energy sources make to Australia's electricity supply to about 12%.

The Renewable Energy (Electricity) Act 2000 and the associated *Renewable Energy (Electricity) Regulations* provide the legislative framework for the implementation of the Government's target. The Act defines eligible renewable energy sources which include wood waste and energy crops. Renewable Energy Certificates (RECs) will be issued to electricity wholesalers who produce eligible forms of renewable energy; RECs are tradeable. The Office of Renewable Energy Regulator (ORER) administers the Act.

2.2.1. Key Regulations

Regulation 7 provides the general requirements for eligible sources of renewable energy. An important feature is that the use of the resource must be ecologically sustainable.

Regulation 8 outlines the criteria that must be met for wood products (waste) to be eligible for RECs. The Regulation covers wood waste from harvesting of native forests, plantations and other sources. Regulation 8 defines eligible wood waste as:

- Biomass, produced from non-native environmental weed species harvested for the control or eradication of the species, or
- A manufactured wood product or a by-product from a manufacturing process, or
- Waste products from the construction of buildings or furniture, or
- Sawmill residue, or
- Wood waste from a harvesting (including thinnings)

Regulation 9 provides that an energy crop, which can be an agricultural or horticultural crop, must be grown for the primary purpose of providing biomass for energy production. Agricultural and horticultural crops are not defined in the Act but it is generally interpreted by the ORER that crops that contain lignin (wood) in the stem are not included in the definition of agricultural and horticultural crops. The many agricultural and horticultural crops that have woody stems are thus ineligible as sources of renewable energy.

2.2.2. Application of the Regulations

Regulation 8 provides some general principles but specifies different conditions for material sourced from native forest and wood waste sourced from plantations.

Native Forests

Wood waste sourced from a native forest must come from a harvesting operation for which the primary purpose is other than obtaining biomass for energy production. Further, native forest wastes must be by-products of harvesting for a high value process (defined in the regulations as the production of poles, sawlogs, veneer, piles, girders, wood for carpentry or craft uses or oil products). Alternatively, the wood waste may be a by-product of a harvesting operation producing thinnings or coppice material that is undertaken in accordance with ecologically sustainable forest management principles.

Plantations

Wood waste from plantations must meet all of the following requirements to be eligible for RECs (these differ from the requirements for wastes from native forest harvesting). The waste must be:

- A product of a harvesting operation, which could include thinnings and coppicing which has been approved under all relevant Commonwealth, State or Territory planning and approval processes; and
- A product for which no higher value than biomass for energy production can be accessed for the products at the time of harvesting; and
- From a plantation managed in accordance with codes of practice which have been approved by the Commonwealth under the Export Control (Unprocessed Wood) Regulations; and
- From a plantation which was not established on land cleared of native vegetation after 31st December 1989 for the purposes of establishing a plantation.

2.2.3. Comment on the Act

It is widely accepted that growing trees to effectively capture carbon dioxide and solar energy to generate energy is completely renewable and is a basic part of the energy policies of many countries. The Australian Government has taken the unusual step of limiting the capacity of the nation to utilise this source of renewable energy.

For plantations, the Regulations require that wood wastes must be the product of a harvesting operation for which no product of a higher financial value than biomass for energy generation production could be produced at the time of harvesting. This introduces uncertainty as there is a risk that wood biomass may cease to be eligible as a renewable energy resource at some time during a project. As most bioenergy projects are capital intensive, the risk that the designated supply of fuel may become unavailable is a major funding consideration. This clause has the potential to effectively eliminate planned investment in wood-based bioenergy projects.

The Regulations also preclude the growing of tree crops for energy. This has a direct impact on the potential use of woody short rotation crops to address environmental problems such as dryland salinity. This aspect of the Regulations is peculiar to Australia – no other nation has singled out woody perennial plants and declared them ineligible as sources of renewable energy

3. ACTIVITIES

Despite the legislative impediments to the use of short rotation crops for bioenergy, a number of projects are proceeding either on the basis of an expectation that the Regulations will be amended or attempting to work within the framework of the legislation.

3.1 Bioenergy from mallee eucalypts in Western Australia

3.1.1. Background

Agricultural development of the Western Australian wheatbelt was initially slow due to the very low fertility of the ancient highly weathered land surface of Western Australia. Development required the clearing of the native vegetation that consisted of forests, woodlands and shrublands but virtually no grasslands. After clearing, large applications of phosphorus and trace elements were applied and introduced annual crops and pastures were sown. Agriculture became very productive and is now a major part of the Western Australian economy; the current annual value of production is approximately A\$4 billion.

The nearly total dependence on annual plants in this agricultural system has caused a serious hydrological imbalance. The shallow rooted annual plants are not able to consume all incoming rainfall. In the generally very flat agricultural landscape most of the unused excess of rainfall infiltrates deep into the subsoil and accumulates as groundwater. Groundwaters fill to intersect the surface, mostly on the valley floors. This sets up a cycle of recharge and discharge of groundwater systems that was not active under the original native vegetation cover. The large storage of salts that was built up in subsoil under the native vegetation cover is mobilized and flushed from the landscape.

The extensive discharge of saline water is a serious economic and environmental problem. Inadequate water use under the present agricultural system is the fundamental driving force of this salinity problem. The problem occurs over virtually all the agricultural land in southwest Western Australia and is common in Eastern Australia, particularly in the River Murray catchment. While land damage by salinity is a serious problem to the farmer, predicted to afflict more than 30% of the landscape within a few decades, downstream damage will be an increasingly serious problem for the community at large. The entire drainage network is being degraded leading to loss of water resources, loss of riverine and valley floor biodiversity, loss of amenity, increased stream flow volume and erosion, instability in valley floor infrastructure due to saturated foundations and increased flood risk.

Salinity has provoked much discussion about the ecological sustainability of agriculture. However, perhaps the greater concern for the farmer is that the present form of agriculture might not be politically sustainable. The downstream impacts of salinity appear severe enough to provoke political demand for comprehensive remedial measures to be developed and applied. The Salinity Action Plan (1998) recognized a significant increase in water use within agriculture was required and that perennial plants offer the best prospect.

3.1.2. Perennial plant options

The scale of planting of perennials necessary to control salinity is in the order of millions of hectares. The cost of establishment will be measured in billions of dollars. To occupy land on this scale, and to attract the necessary capital investment, perennials will generally have to pay their way as well as improve water use. Oil mallee was identified as the most prospective development initiative available.

3.1.3. Narrogin Project

The oil mallee project commenced planting in 1994 at several Western Australian wheatbelt regions one of which was around the town of Narrogin. To date some 6000 ha of oil mallee crop has been established by landholders, most commonly in regular wide-spaced belt configuration known as ‘alley farming’. The stems and branches from these belts of mallee can be harvested for biomass on a 2 to 4 year cycle and the mallee sprouts back from the stump after harvest.

Western Power Corporation, the State owned power utility in Western Australia, expects to soon commence building an integrated wood processing (IWP) demonstration plant that will generate renewable electricity and will produce activated carbon and eucalyptus oil from biomass harvested from the mallee crops. By combining a range of products, the project provides a potentially commercially competitive operation.

Biomass is separated into woody stems and leaves. The wood in the stems is converted to charcoal using fluidised bed technology and then “activated” to convert it to activated carbon, a product widely used in air and liquid purification. The leaves are distilled to produce eucalyptus oil for the pharmaceutical market and as an industrial solvent. Heat from the charcoal and carbon processes and from the residue leaf will be used to generate renewable electricity (Bartle and Giles 2000).

Enecon Pty Ltd will work with Western Power on the design, construction and operation of the plant. The eucalyptus oil distillation component of the plant will be supplied by the Oil Mallee Company of Australia Pty Ltd.

The IWP demonstration plant will have an intake of 20,000 t/a of biomass and will produce:

- 7.5 GWh/a of electricity from a 1 MW steam turbine
- 690 t/a activated carbon
- 210 t/a eucalyptus oil

Studies are in progress to develop appropriate harvesting systems that will handle the high-density wood, heavy crowns and the large stem diameter of the mallee eucalypts. The European harvesters designed for willows are unsuited to the task.

3.1.4. Esperance Project

Metasource (a subsidiary company of Woodside Energy Ltd) and the Oil Mallee Company of Australia were involved with a second project that planned to provide power to the town of Esperance. Esperance is a remote town on the southern coast of Western Australia that is not connected to the State’s electricity grid and is remote from energy sources such as coal and gas. The cost of producing electricity in Esperance is high.

Metasource tendered to build a 5 MW biomass – fired power station in the town of Esperance. Mallee eucalypts were to be grown as the energy source with benefits expected to flow both to electricity users and to farmers as a tool to assist in the amelioration of salinity. Metasource was not successful

but won reserve tenderer status. The winning tenderer has not yet commenced construction and it appears likely that tenders may be re-called

3.2 Short rotation crops of *Casuarina* for bioenergy and charcoal

BioEnergy Australia Ltd (a company formed in 2000 and unrelated to the Bioenergy Australia alliance) has announced plans to establish mixed species plantations combining high-value species between strips of *Casuarina spp.* The high-value species will be high pruned and grown at wide spacing to develop large diameter, knot-free wood at an early age. The *Casuarina* element will be grown as a coppiced short-rotation crop providing shelter and nitrogen fixing capacity during the period that the *Casuarina* is present.

BioEnergy Australia expects products such as charcoal and activated carbon to be produced from the *Casuarina* with waste products being used to generate renewable energy.

To date the company is only developing plantations in Western Australia but expects to adapt the principles to other areas within Australia. As with Western Australia, salinity has had a severe impact on agricultural lands and the rivers that flow through. *Casuarina* provides another crop that could be used to ameliorate salinity but, under current Regulations, is precluded as a short rotation energy crop.

3.3 Forest and sawmill residues for bioenergy

While these fall outside the scope of Task 30 (short rotation cropping) it is important to understand the key developments, as opportunities for the supply of additional resource through short-rotation crops are likely to become available.

3.3.1 Auspine bioenergy plant – Tarpeena, South Australia

Auspine Ltd has announced their intention to build a 60 MW bioenergy plant at Tarpeena in South Australia. The Auspine project will source resource from sawmill residues and from thinnings of its plantation resource. Energy will be supplied to the electricity grid that connects all Eastern States of Australia and will allow a source of renewable energy to be provided to a wide range of customers.

At this point in time Auspine does not intend to utilise short rotation crops as a tool to produce fibre for energy production but this situation may change as opportunities to more effectively use the land available on or around the Auspine estate develop.

3.3.2. Visy Pulp and Paper – Tumut, New South Wales

Visy Pulp and Paper recently completed the construction of a pulpmill at Tumut, New South Wales. The pulpmill utilises pulpwood from thinning and sawmill residue woodchips from radiata pine plantations grown in the area as its resource. As part of the pulpmill design, the capacity to generate 19 MW of renewable energy (electricity) was included. The bioenergy facility uses a wide range of wood wastes including sawdust, bark, and municipal wood waste; in fact any available waste wood fuel is used.

At this point in time Visy does not intend to utilise short rotation crops as a tool to produce fibre for energy production due to cost factors but again this situation may change as opportunities to more effectively use the land available develop.

3.4 Wood fibre to supplement bagasse

One of the main sources of biomass fuel for bioenergy plants in Australia is bagasse. Bagasse, a by-product of sugar manufacture, is suitable for electricity generation and is readily available along a coastal strip from northern New South Wales to Far North Queensland.

The raw material typically has a high moisture content which adversely impacts upon its value as a fuel. Invariably the availability of bagasse is limited to the sugar harvesting season that can last up to eight months. Storing surplus bagasse for use outside the harvesting season tends to be unsuccessful with bacterial degradation of the material in storage and unpleasant odours impacting upon nearby residents. To remain efficient, however, it is important to have additional sources of biomass. A number of agricultural crops have been proposed and this may provide a partial solution. Other residues including sawmill or forest residues are also an opportunity but, in many cases, are ineligible under the Renewable Energy Act and thus not a proposition.

Residues from thinning or processing residues from plantations, however, are likely to be eligible and this provides opportunities to supplement bagasse outside the cane harvest system. Technologies such as proposed by BioEnergy Australia Ltd may provide the opportunity to meet this requirement.

3.5 Wastewater irrigated plantations for energy

Apart from commercial wood production for bioenergy and other products, increased interest in the establishment of tree plantations in southern Australia has resulted from a recognition that integration of trees into farming systems is required to halt land degradation from rising groundwater and consequent salting. There has also been increasing environmental and regulatory pressure to stop wastewater disposal to waterways and beneficially re-use wastewater won land. This is particularly so in much of inland southern Australia having low rainfall, requiring wastewater disposal options and having a limited traditional forest products industry for timber or fibre.

A number of studies have been undertaken in Southern Australia to investigate the productivity and sustainability of effluent-irrigated short-rotation tree plantations and their silvicultural management. These include projects at Wagga Wagga and Albury in New South Wales, Shepparton in Victoria, and Bolivar in South Australia.

Despite the very high growth rates observed, bioenergy production from wastewater-irrigated plantations can at most contribute only a very small proportion of total energy production in Australia simply because of the limited volume of the wastewater resource. However, the development of such plantations can make a relatively large contribution to solving a wastewater disposal problem. Moreover, this small-scale solution is particularly applicable to regional Australia and with potential application for energy and environmental purposes in developing countries.

4. CONCLUSION

Recent initiatives from the Australian Government have resulted in a dramatic increase in activity in the field of renewable energy. These initiatives effectively preclude woody short rotation energy crops while promoting other renewable energy sources including non-woody short rotation energy crops. Other restrictions on the use of wood waste, particularly the higher value at time of harvest test, severely limit the ability of renewable energy projects based on wood products to attract funding.

Given this situation, the adoption of woody short rotation crops in Australia is likely to be slow. There are a number of projects at early stages of development where short rotation crops are grown for other purposes (such as oil, charcoal, pulp, wastewater disposal) and have biomass for energy as a residual product or where the short rotation crop is a component of a multi species high-value timber crop where the concept may be adopted.

Given the vast environmental problems in much of inland Australia that have been caused through removal of perennial vegetation, it is difficult to imagine that the strongest economic solution available (short rotation cropping of woody species for energy production) has been rejected by environmental groups. Australia needs the technical support of IEA Bioenergy Task 30 to continue to make unbiased and soundly-based information available to all sectors of the community; perhaps then current laws can be changed.

5. References

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