

BIOENERGY KNOWLEDGE CENTRE



Library Update April 2007

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Current Articles and Reports

Pellets appeal: Where to now for the pellet heating market in Europe? By Griffiths M. Renewable Energy World March 02 2005

This article draws from several papers published in the Proceedings of the 2004 European Pellet Conference. Topics that are discussed include; producing the perfect pellet, large-scale pellet heating in practice, and pushing the pellet market. (To request email library@energylibrary.org.nz and quote **Bio2Griffiths**)

Overview of applications of biomass fast pyrolysis oil By Czernik S and Bridgwater A. Energy and Fuels V18/2 2004

This review critically analyses the technical and scientific developments in the field of fast pyrolysis. This is a commercially successful technique that leads to the production of the renewable liquid, bio-oil. The advantages of this renewable energy source are described.

(To request email library@energylibrary.org.nz and quote **Bio2Czernik**)

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Information note on the use and potential of biomass energy in OECD countries COM/ENV/EPOC/AGR/CA(98)147/ FINAL Organisation for Economic Co-operation and Development 2000

Topics covered in this paper include: The use and potential of biomass conversion to electricity, heat and fuel oils; cost of switching from conventional energy sources to biomass energy; potential contribution to reduction of greenhouse gas emissions; availability of biomass from agricultural and forestry residue as well as dedicated production and conversion efficiencies.

(To request email library@energylibrary.org.nz and quote **Bio2EPOC**)

Biomass as an energy source By Schuck S. International Journal of Environmental Studies V 63/6, 1 2006

Available technologies and policy influences from within Australia and internationally are discussed. Some of the related topics included in this review are liquid biofuels, the International Energy Agency's Bioenergy program, and Bioenergy Australia's activities.

(To request email library@energylibrary.org.nz and quote **Bio2Shuck**)

IEA Energy Technology Essentials OECD/IEA January 2007:

This site briefly summarises the latest information on energy technologies in biofuel. Production process, energy input, emissions, cost comparisons, global potential and barriers faced by the bioenergy production industry are discussed. Relevant statistics from the *IEA World Energy Outlook 2006* are included. Statistics relating to ethanol and biodiesel feedstock production, costs and emissions data for bioethanol and biodiesel production are also given.

(To request email library@energylibrary.org.nz and quote **Bio2Tech**)

Fuel Value Calculator By Forest Products Laboratory.

The fuel calculator was developed to enable the comparison of different fuel types. A comparison of the different efficiency, heating values and costs for a variety of fuels are given, demonstrating that wood is now a competitive alternative to fossil fuels. This article provides example calculations of annual home heating costs for a variety of fuel types and discusses a few of the influencing variables. It links to an Excel spreadsheet that enables further calculations by the reader.

(To request email library@energylibrary.org.nz and quote **Bio2Calculator**)

High Temperature Aerosol Formation and Emission Minimisation during Combustion of Wood Pellets DOCTORAL THESIS Wiinikka H. 2005

The removal of particulate matter produced during the combustion of solid biomass is increasingly difficult when small scale equipment is used. This study explores and identifies several mechanisms that are likely to play a role in their formation. It is hoped that the results from this study may enable the design of a system which can reduce particle emissions already in the combustion process.

(To request email library@energylibrary.org.nz and quote **Bio2Wiinikka**)

Fuel to Burn: Economics of Converting Forest Thinnings to Energy Using BioMax in Southern Oregon Bilek et al. United States Department of Agriculture USDA General Technical Report FPL-GTR-157 2005

This study investigates the economic feasibility of selected gasification plants to supply electricity to the national grid utilising forest thinnings. The provision of tax credits, proximity of existing power lines and other influencing factors are explored. Objectives

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of this study were to: evaluate the economics of operating generators at a forest landing; demonstrate likely wood and cash flows using a BioMax generator; and determine the impact of distributed energy generation on energy supplies in fifteen selected states within the USA. Findings indicated that biomass from a selection of states had the potential to provide from 2.3-14.3 billion kWh of electricity to the national grid.

(To request email library@energylibrary.org.nz and quote **Bio2Bilek**)

Bioenergy innovations: The case of wood pellet systems in Sweden By Mahapatra *et al.* Technical Analysis and Strategic Management V 19/1 2007

This study shows that energy policy, dissemination of district heating systems and raw material abundance appear to positively affect market growth. Also discussed are factors contributing to the relatively slow growth of the small-scale systems market.

(To request email library@energylibrary.org.nz and quote **Bio2Mahapatra**)

Effect of different configurations on small pellet combustion systems Moran J *et al.* Energy Sources, Part A: Recovery, Utilization and Environmental Effects V 28/12 2006

The main control factors influencing optimal stove performance in pellet combustion were investigated. Variables such as preheating of air, secondary air supply and gas recirculation were explored. Methods of reducing CO emissions were established.

(To request email library@energylibrary.org.nz and quote **Bio2Moran**)

Some CHP Options for Wood-Fired Fuel Cells McIlveen-Wright D *et al.* 7th Biennial Conference on Engineering Systems Design and Analysis 2004

This study assessed wood gasification integrated with fuel cell systems in CHP configurations, for a selection of building systems with a variety of energy demand profiles. Representative heat and electricity use profiles were developed. The electrical efficiency, waste heat recovery and economic factors were analysed.

(To request email library@energylibrary.org.nz and quote **Bio2M-Wright**)

Conflict over biomass energy development in the United Kingdom: some observations and lessons from England and Wales By Upreti B, Energy Policy V32/6 2004

The aim of this paper is to examine the causes of conflict over biomass energy development in the United Kingdom. This paper discusses social dimensions of development of biomass power plants. Based on the four case studies from England and Wales this paper examines impacts of public oppositions on planning permission. This paper reveals that public opposition is one of the major obstacles to promote biomass energy. Though local communities value environmental benefits of biomass energy, they concern more on the immediate negative local effects of power plants to their areas. Main sources of public conflict over biomass energy development were related to location of the plant, perceived risks, and negative effects to ecology and landscape compared to few economic benefits to local people. Other factors contributing to the conflict were feeling of injustice, weak public relation strategy of the developers and low level of awareness. The paper concludes that biomass energy can be promoted only if all actors: the central government, developers, local councils, environmental concern groups and local communities make collective efforts. Such collaborative efforts need drastic shift in the current approach of biomass energy development.

(To request email library@energylibrary.org.nz and quote **Bio2Upreti**)

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Papers of interest from the World Renewable Energy Congress VII & Expo 29 June – 5 July 2002

Wood Fuelled Combined Heat and Electricity Demonstration Pland in N and Implementation of CHP at Beddington Zed, London By Kernohan P. 2002
(To request email library@energylibrary.org.nz and quote **Bio2Kernohan**)

A Revolution in Anaerobic Digestion By Maltin. 2002
(To request email library@energylibrary.org.nz and quote **Bio2Maltin**)

Planning and Construction of Biogas Plants for Solid Wasted Digestion in Agriculture By Fischer T and Krieg. 2002
(To request email library@energylibrary.org.nz and quote **Bio2Fischer**)

Fast Pyrolysis of several biomass Materials By Guo et al. 2002
(To request email library@energylibrary.org.nz and quote **Bio2Guo**)

Papers of interest from the Forest Products Society 60th International Convention 2006

An integrated approach to fuels treatment in the southwestern US – the harvest cost-revenue estimator Lowell E. 2006
(To request email library@energylibrary.org.nz quote **Bio2Lowell**)

Identifying and developing innovation in harvesting and transporting forest biomass Kellogg L *et al.* 2006
(To request email library@energylibrary.org.nz and quote **Bio2kellogg**)

Chemical and physical characterization of bio-oils from pine and oak feed stocks Mitchell B 2006 Integrated forest bioproducts research for northeastern species
By Shaler S.M. 2006
(To request email library@energylibrary.org.nz and quote **Bio2Mitchell**)

Forest fuels reductions and biomass to energy; Cost avoidance and non-market value analysis indicates public benefits are underestimated Mason D. 2006
(To request email library@energylibrary.org.nz and quote **Bio2Mason**)

Incentives and subsidies needed to enable the utilization of woody biomass for the production of energy Leightley L. 2006
(To request email library@energylibrary.org.nz and quote **Bio2Leightley**)

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Integrated forest bioproducts research for northeastern species By Shaler S. 2006

(To request email library@energylibrary.org.nz and quote **Bio2Shaler**)

Forest biomass potential for pyrolysis- raw material issues and potential products By Green D. Forest products society 60th International Convention 2006

(To request email library@energylibrary.org.nz and quote **Bio2Greene**)

Life-cycle modelling of public costs and benefits from the use of wildland biomass for electricity production Nechodom M. 2006

(To request email library@energylibrary.org.nz and quote **Bio2Nechodom**)

Bioenergy Australia 2006 conference CD

The latest Bioenergy Australia conference 2006 CD includes a significant number of presentation abstracts and other conference related material from a broad range of experts in the field of bioenergy. Supporting information on each presentation is provided in point form, and although the readability varies from presentation to presentation some current and informative information is provided.

- *Clean and Renewable Energy from Australia* Business Overview By Harper G from Plantation Energy. This is an Australian company that manufactures and exports densified biomass fuel pellets from blue gum and pine harvest residues.
- *A growth opportunity for Energy and the Environment* conference overview of the Bioenergy Australia 6th Annual conference 2006 By Ralph Sims.
- *Biomass, food of fodder? Best land use and trade-offs.* Panel Discussion, Bioenergy Australia Conference: Biomass for energy, the environment and society.

(To request CD email library@energylibrary.org.nz and quote **Bio2CD**)

Wood Pellet Standards

AS/NZS 5078:2007

How to evaluate the average efficiency and thermal output from automatic feed and pellet fuel-burning room heaters designed for burning wood pellets and other suitable solid fuels

(To request email library@energylibrary.org.nz and quote **Bio2-5078**)

AS/NZS 4886: 2007

For determining the rate of particulate emissions from domestic pellet burning appliances and specifications on particulate emission acceptance criteria.

(To request email library@energylibrary.org.nz and quote **Bio2-4886**)

BIOENERGY KNOWLEDGE CENTRE

Carbon emission and mitigation cost comparisons between fossil fuel, nuclear and renewable energy resources for electricity generation Sims R *et al*, Energy Policy V31/ 13 2003

A study was conducted to compare the electricity generation costs of a number of current commercial technologies with technologies expected to become commercially available within the coming decade or so. The amount of greenhouse gas emissions resulting per kWh of electricity generated was evaluated. A range of fossil fuel alternatives (with and without physical carbon sequestration), were compared with the baseline case of a pulverised coal, steam cycle power plant. Nuclear, hydro, wind, bioenergy and solar generating plants were also evaluated. The objectives were to assess the comparative costs of mitigation per tonne of carbon emissions avoided, and to estimate the total amount of carbon mitigation that could result from the global electricity sector by 2010 and 2020 as a result of fuel switching, carbon dioxide sequestration and the greater uptake of renewable energy. Most technologies showed potential to reduce both generating costs and carbon emission avoidance by 2020 with the exception of solar power and carbon dioxide sequestration. The global electricity industry has potential to reduce its carbon emissions by over 15% by 2020 together with cost saving benefits compared with existing generation.

(To request email library@energylibrary.org.nz and quote **Bio2Sims**)

Thermal performance of combined solar and pellet heating systems Fiedler F *et al*, Renewable Energy V31/1 2006

Various pellet heating systems are marketed in Sweden, some of them in combination with a solar heating system. Several types of pellet heating units are available and can be used for a combined system. This article compares four typical combined solar and pellet heating systems. System 1 and 2 with a pellet stove, system 3 with a store integrated pellet burner and system 4 with a pellet boiler. The often lower efficiency of pellet heaters compared to oil or gas heaters increases the final energy demand. Consequently, heat losses of the various systems have been studied. The systems have been modelled in TRNSYS and simulated with parameters identified from measurements. For almost all systems the flue gas losses are the main heat losses except for system 3 where store heat losses prevail. Relevant are also the heat losses of the burner and the boiler to the ambient. Significant leakage losses are noticed for system 3 and 4. For buildings with an open internal design system 1 is the most efficient solution. Other buildings should preferably apply system 2 or 3. The right choice of the system depends also on whether the heater is placed inside or outside of the heated area. Unlike the expectations and results from other studies, the operation of the pellet heaters with modulating combustion power is not necessarily improving the performance. A large potential for system optimisation exists for all studied systems, which when applied could alter the relative merits of the different system types.

(To request email library@energylibrary.org.nz and quote **Bio2Fiedler**)

Development and implementation of integrated biomass supply analysis and logistics model (IBSAL) By Sokhansanj *et al*, Biomass and Bioenergy V30,10 2006

This paper describes the framework development of a dynamic integrated biomass supply analysis and logistics model (IBSAL) to simulate the collection, storage, and transport operations for supplying agricultural biomass to a biorefinery. The model consists of time dependent events representing the working rate of equipment and queues representing the capacity of storage structures. The discrete event and queues are inter-connected to represent the entire network of material flow from field to a biorefinery. Weather conditions including rain and snow influence the moisture content

BIOENERGY KNOWLEDGE CENTRE

and the dry matter loss of biomass through the supply chain and are included in the model. The model is developed using an object oriented high level simulation language EXTEND™. A case of corn stover collection and transport scenario using baling system is described.

(To request email library@energylibrary.org.nz and quote **Bio2Sokhansanj**)

Addressing Scottish rural fuel poverty through a regional industrial symbiosis strategy for the Scottish forest industries sector Illsleya B *et al*, Geoforum V38/1 2007

Tackling fuel poverty is central to the delivery of the Scottish Executive's commitment to social justice. Many Scottish rural households are not linked into the mains gas network and rely on expensive alternatives, despite being surrounded by plentiful supplies of low-cost renewable wood biomass. A regional study was undertaken to establish the potential market for palletised wood fuel, available as a low-value by-product from the rapidly expanding Scottish forest industry sector. The wider implications of the research findings are analysed by extending the principles of industrial symbiosis from a site-specific to a regional scale. Promoting an indigenous pellet-based wood fuel market for rural Scotland would fulfil important Scottish Executive economic, social and environmental sustainability objectives. Adding off-site social symbiotic elements increases the potential for on-site technical symbiosis in nascent Scottish forest industry clusters. At present, market failure is preventing the realisation of these benefits, and the paper concludes by identifying ways in which market intermediation, through wood fuel energy service companies, might overcome the current barriers to exploiting such symbiosis.

(To request email library@energylibrary.org.nz and quote **Bio2Illsleya**)

Biomass power cost and optimum plant size in western Canada Kumar A *et al*, **Biomass and Bioenergy** V24/62003

The power cost and optimum plant size for power plants using three biomass fuels in western Canada were determined. The three fuels are biomass from agricultural residues (grain straw), whole boreal forest, and forest harvest residues from existing lumber and pulp operations (limbs and tops). Forest harvest residues have the smallest economic size, 137 MW, and the highest power cost, \$63.00 MWh⁻¹ (Year 2000 US\$). The optimum size for agricultural residues is 450 MW (the largest single biomass unit judged feasible in this study), and the power cost is \$50.30 MWh⁻¹. If a larger biomass boiler could be built, the optimum project size for straw would be 628 MW. Whole forest harvesting has an optimum size of 900 MW (two maximum sized units), and a power cost of \$47.16 MWh⁻¹ without nutrient replacement. However, power cost versus size from whole forest is essentially flat from 450 MW (\$47.76 MWh⁻¹) to 3150 MW (\$48.86 MWh⁻¹), so the optimum size is better thought of as a wide range.

None of these projects are economic today, but could become so with a greenhouse gas credit. All biomass cases show some flatness in the profile of power cost vs. plant capacity. This occurs because the reduction in capital cost per unit capacity with increasing capacity is offset by increasing biomass transportation cost as the area from which biomass is drawn increases. This in turn means that smaller than optimum plants can be built with only a minor cost penalty. Both the yield of biomass per unit area and the location of the biomass have an impact on power cost and optimum size. Agricultural and forest harvest residues are transported over existing road networks, whereas the whole forest harvest requires new roads and has a location remote from existing transmission lines. Nutrient replacement in the whole forest case would make power from the forest comparable in cost to power from straw.

(To request email library@energylibrary.org.nz and quote **Bio2Kumar**)

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Use of energy analyses in silvicultural decision-making By Mead D and Pimentel D, Biomass Bioenergy V30/4 2006

Plantation managers use a variety of decision-support systems to assist in deciding on optimum silvicultural treatments. Often these include computer-based growth simulation models that include an economic analysis. We recommend that energy analyses should be added as an additional tool, to ensure that fossil and other energy is used wisely and to meet other objectives such as reducing environmental impacts.

In this study, selected silvicultural inputs were evaluated for hypothetical *Eucalyptus grandis* and *Pinus taeda* plantations. Silvicultural treatments resulted in very large differences in energy output: energy input ratios, with very high ratios being associated with treatments that result from a change of site quality by overcoming major soil limiting factors. Machinery choice and other material inputs such as fertilizers and herbicides also influenced energy balance ratios. The use of nitrogen fertilizers was an energy-intensive option. The coppice eucalyptus plantation often had higher energy balance ratios than the pine because of its faster growth rate and higher basic wood density. Evaluating a combination of silvicultural treatments was not as helpful for optimizing energy balance ratios as evaluating them separately.

Yield responses vary widely with species, sites and a range of operational factors. Thus determining the yield response required for a silvicultural treatment to meet a prescribed energy output: input ratio would allow managers to quickly evaluate treatments. In this study, we used an energy balance ratio of 25 as a criterion. Some treatments would have met this standard while others were marginal or the responses could not meet the criterion. However, the selection of the critical ratio needs further study. Net energy yield per hectare, evaluated for various silvicultural options, would be a useful measure in planning energy-use systems for forest estates that supply bioenergy industries. It was a less sensitive measure than energy balance for comparing different silvicultural treatments.

(To request email library@energylibrary.org.nz and quote **Bio2Mead**)

Kinetics of pyrolysis, combustion and gasification of three biomass fuels

Senneca O, Fuel Processing Technology V 88/1 2007

The paper compares the microstructural properties and the intrinsic reactivity of pine seed shells, olive husk and wood chips upon pyrolysis, combustion and gasification (with CO₂ and H₂O). Such biomasses, all of interest in energy production, are quite different from one another in terms of O/C and H/C content, of porosimetric structure and of ash content. An extensive campaign of isothermal and non-isothermal thermogravimetric experiments allowed to assess the reactivity of the fuels and to obtain kinetic expressions for the main reactive processes (pyrolysis, char combustion and char gasification). Olive husk turned out to be the most reactive material, followed by wood chips and pine seed shells. Differences of reactivity are particularly pronounced in the case of char combustion. The high reactivity of olive husk has been related to its high content of mineral inclusions, compared with the other biomasses, coupled with a relatively accessible porous texture. The porous structure of the biomass chars turned out to determine also the changes in reactivity along conversion.

(To request email library@energylibrary.org.nz and quote **Bio2Senneca**)

Technologies of wood combustion By Strehler A, Ecological Engineering V16, Sup 1 2000

Wood is the oldest but even today the most important carrier of solar energy. The actual potential of wood energy depends on waste- or by product quantities, which have no better use in the non energy sector and of energy plantations via short rotation forestry. The economical sensitive potential depends additional on the energy-price-level. The fuel characteristics with low ash and low sulfur content allow the

BIOENERGY KNOWLEDGE CENTRE

comparison with straw (high ash-c.) coal, oil, and gas. The most important aspect of wood as renewable energy carrier is its nearly closed C-circle. Wood is processed to wood logs (discontinuous charging) and wood chip and/or pellets (automatic charging). Wood log furnaces have to be combined with heat stores (100 l/kW) to avoid emission problems with a heating performance below 50%. Wood chip and pellet furnaces allow similar handling comfort as oil fired boilers. The costs of energy from wood are in the range of 0.06–0.15 DM/kWh. Heating oil leads to total cost of 0.07–0.11 DM/kWh with a oil price of 0.40 DM/l.

(To request email library@energylibrary.org.nz and quote **Bio2Strehler**)

Influence of fuel ash composition on high temperature aerosol formation in fixed bed combustion of woody biomass pellets Wiinikkaa H *et al*, Fuel V86, 2007

In this work, the influence of fuel ash composition on high temperature aerosol formation during fixed bed combustion of woody biomass (two wood pellets and one bark pellets) were investigated experimentally in a laboratory reactor and theoretically through chemical equilibrium model calculations. For all fuels, the particle mass size distribution in the PM_{2.5} region was bimodal, with one fine mode and one coarse mode. Early in the flame, the fine mode was dominated by particles from incomplete combustion and these particles were rapidly oxidised in the post flame zone. After the hot flame, the fine mode concentration and the particle diameter increases gradually when the temperature decreases due to condensation of vaporised inorganic matter, K, Na, S, Cl, and Zn. For two of the fuels also P could be found in the fine particles. The coarse mode consisted of carbon, refractory metals and considerable amount of alkali. Further, the initial fuel alkali concentration and the alkali to silicon ratio (K + Na)/Si influenced the amount of vaporised aerosol forming alkali matter. Finally, the present study shows that, combustion temperature and fuel ash composition is of major importance for the formation of high temperature aerosols in fixed bed combustion of woody biomass pellets.

(To request email library@energylibrary.org.nz and quote **Bio2Winniikka2**)

Weblinks

[This Energy Efficiency Conservation Authority \(EECA\) biomass site](http://www.eeca.govt.nz/renewable-energy/bioenergy/biomass.html) provides comprehensive information on woody biomass as an energy resource.
www.eeca.govt.nz/renewable-energy/bioenergy/biomass.html

[The following page](http://www.scionresearch.com/bioenergy.aspx?PageContentID=106) by SCION provides a selection of recent articles relating directly to woody biomass for energy in New Zealand. Links to other relevant online resources are accessible from this page. www.scionresearch.com/bioenergy.aspx?PageContentID=106

Below is a selection of [links from the IEA](#) bioenergy web site:

[IEA Biomass Combustion](http://www.ieabcc.nl/) and Cofiring web site www.ieabcc.nl/

[The U.S. Department](http://www1.eere.energy.gov/biomass/about.html) of Energy's Office of Energy Efficiency and Renewable Energy Office of the Biomass Program (OBP) www1.eere.energy.gov/biomass/about.html

[Regional Wood Energy](http://www.rwedp.org/) Development Programme in Asia <http://www.rwedp.org/>

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