Khraisha Y H, Hamdan M A, and Quibia J M. 2001
Energy Sources **23**(8): 757–765

Faculty of Engineering and Technology, University of Jordan, Amman 11942, Jordan
<khraisha@fet.ju.edu.jo>

axis of the flame, and the flame temperature was decreased as A/F ratio or percentage of SLO in the fuel mixtures was decreased. The maximum percentages of SLO that can be mixed with kerosene or diesel and then burned in the combustion unit are 40% and 15% respectively. Combustion and thermal efficiencies were increased as A/F ratio increased and then decreased for higher A/F ratios. (9 figures, 2 tables, 7 figures)

Biomass

[23]

New trends in developing biodiesel worldwide

RME (Rapeseed oil-methyl-ester) was the first type of biodiesel fuel produced commercially in 1988, characterized as a single-feed-stock product of then questionable quality. Tremendous progress has been made in the past 12 years by (1) broadening the feedstock basis beyond rapeseed oil, (2) improving process technology, (3) developing sophisticated fuel standards thus assuring highest fuel quality, (4) establishing capacities in many countries all over the world, (5) intelligent product positioning in defined fuel market segments, (6) obtaining numerous warranties from diesel engine producers, and (7) implementing different supportive legal measures and voluntary regulations. (2 figures, 2 tables)

Körbitz W
IREDA News **12**(4): 23–27
Austrian Biofuels Institute, P O Box 97, A-1014 Vienna, Austria
<werner.koerbitz@biodiesel.at>

[24]

Biomass equations and estimation for *Gmelina arborea* and *Nauclea diderrichii* stands in Akure forest reserve

The increasing desire for total tree utilization and the need to express yield in terms of weight rather than volume has stimulated studies of biomass production. In this study, the biomass estimation was carried out for even-aged strands of *Gmelina arborea* and *Nauclea diderrichii* in the Akure forest reserve of Nigeria. Linear and allometric regression equations for biomass prediction were developed for trees of both the species. The yield of each species and TAGB (total above-ground biomass) were estimated and compared. It was found that more than 75% of total biomass yield for both the species were from the stem and over 90% of the TAGB could be available as biofuel with *Gmelina arborea* having more biomass than *Nauclea diderrichii*. The biomass equations developed in this paper are recommended for predicting total biomass production and the biomass of components for the two species. (4 tables, 8 references)

Fuwape J A, Onyekwelu J C, and Adekunle V A J. 2001
Biomass and Bioenergy **21**(6): 401–405

Department of Forestry and Wood Technology, Federal University of Technology P M B 704, Akure, Nigeria

[25]

Biofuel availability and domestic use patterns in Kenya

The lack of reliable biofuel consumption data for most developing countries, has created a situation that has hampered the efforts to quantify the contribution of emissions from domestic biomass burning to the global atmospheric trace gas budgets. This study highlights important biofuel use patterns, particularly those relating to vegetation species and annual consumption levels in Kenya. The total annual fuel consumption depended on availability but varied with ecological potential, being highest in the highlands zone and lowest in the arid and semi-arid lands. The spatial annual consumption patterns were also influenced by population density and ambient temperature variations. The reported good biofuel sufficiency across the country may be interpreted in terms of the availability of many (though not necessarily preferred) species to which households may switch-over with relative ease. From a similar perspective, the biofuel scarcity reported in some areas may be seen in terms of depleted preferred species, a situation to which households have responded by switching to other available types on farmlands and in protected forest resources. The dwindling quantities of major biofuel tree species is not entirely attributed to harvesting for fuel, but to competing demand for timber, food crop cultivation and human settlement. Without urgent policy intervention, depletion of other currently abundant species may be witnessed in the long-term with implications on the overall biofuel consumption. (6 tables, 34 references)

Kituyi E, Marufu L, Wandiga S O, Jumba I O, Andreae M O, Helas G. 2001
Biomass and Bioenergy **20**(2): 71–82

Biochemistry Department, Max Planck Institute for Chemistry, PO Box 3060, D-55020 Mainz, Germany

Effect of mixing digested slurry on the rate of biogas production from dairy manure in batch fermenter

[26] Forty kilograms of pure cattle dung and cattle dung mixed with 10% digested slurry obtained from a field biogas plant was batch fermented in horizontal biogas digesters for 15 weeks under field conditions with a mean ambient temperature of 20–23 °C. Compared to 821 litres of biogas from digester I, containing cattle dung alone, 1457 litres of biogas was obtained from digester II, containing cattle dung mixed with 10% digested slurry. Mixing of slurry not only speeded up the gas production but also enhanced its rate from 108 litres/kg dry matter to 158 litres/kg dry matter. It also resulted in 36.1% distraction of total volatile solid in digester II, compared to 23.93% observed in digester I. Mixing digested slurry is recommended for raising biogas production from cattle dung in dry fermenters. (2 figures, 2 tales, 5 references)

Kalia A K and Singh S P. 2001
Energy Sources **23**(8): 711–715

Department of Agricultural Engineering, HP Krishi Vishvavidyalaya, Palampur – 176 062, India <akkalia@hpkv.hp.nic.in>

Assessment of biomass potential for power production: a GIS based method

[27] In this study a method is presented, which estimates the potential for power production from agriculture residues. A GIS DSS (decision support system) has been developed, which implements the method and provides the tools to identify the geographic distribution of the economically exploited biomass potential. The procedure introduces a four level analysis to determine the theoretical, available, technological and economically exploitable potential. The DSS handles all possible restrictions and candidate power plants are identified using an iterative procedure that locates bioenergy units and establishes the needed cultivated area for biomass collection. Electricity production cost is used as a criterion in the identification of the sites of economically exploited biomass potential. The island of Crete is used as an example of the decision-making analysis. A significant biomass potential exists that could be economically and competitively harvested. The main parameters that affect the location and number of bioenergy conversion facilities are plant capacity and spatial distribution of the available biomass potential. (7 figures, 2 tables, 27 references)

Voivontas D, Assimacopoulos D, and Koukios E G. 2001
Biomass and Bioenergy **20**(2): 101–112

Department of Chemical Engineering, National Thermal University of Athens, Zografou Campus, GR–157 80, Athens, Greece <assim@chemeng.ntua.gr>

Biofuel consumption rates and patterns in Kenya

[28] The energy-use patterns among the household and commercial sectors have drawn considerable attention from planners and policy-makers, in order to check the rapid deforestation and rising prices of commercial energy required to meet the needs of

the growing population. This paper presents the results of a questionnaire survey conducted in rural and urban Kenya to establish biofuel consumption rates and patterns. Firewood was the main biofuel used, mostly by the rural households, who consumed the commodity at average consumption rates in the range 0.8–2.7 kg/cap/day. Charcoal was mostly consumed by the urban households at weighted average rates in the range 0.18–0.69 kg/cap/day. Biofuel availability was identified as a major factor determining the biofuel consumption rates and patterns. Although the interviews conducted through the questionnaire revealed a healthy biofuel availability situation, there were increasing difficulties in accessing these resources. The results suggest that policies are needed that may ensure equitable biofuel access, sustainable biofuel resource use, and poverty eradication. (4 figures, 8 tables, 44 references)

Kituyi E, Marufu L, Huber B, Wandiga S O, Jumba I O, Andreae M O, Helas G. 2001
Biomass and Bioenergy **20**(2): 83–99

Biochemistry Department, Max Planck Institute for Chemistry, PO Box 3060, D-55020 Mainz, Germany <gth@mpch-mainz.mpg.de>

A chain of technologies for using sugar cane trash as a household fuel

[29] After harvesting sugar cane its leaves are left behind, which cannot be used as a fertilizer, or fodder or fuel as they are non-biodegradable, highly indigestible, and have bulky and low density biomass. This paper discusses a chain of technologies developed by the ARTI (Appropriate Rural Technology Institute) which can be used to convert sugar cane trash into useful household fuel. The chain involves (1) conversion of sugar cane trash to char, by an environment-friendly, continuous batch process; (2) briquetting of the char into a solid fuel form; (3) use of an efficient, clean, and user-friendly stove ideally suited for briquettes as fuel. The techno-economic feasibility of each link has been tested. The manufacturing technologies involved in each step are easy to implement in rural areas, and therefore, the chain also provides new income generating opportunities in rural areas. This charring technology developed by ARTI can be used for charring or charcoaling of any type of biomass for any purpose. (5 figures)

Karve P, Mahajan H Y, Salunkhe R M, Kavve A D. 2001
Boiling Point **47**(Autumn): 16–18

Smt Kashibai Navale College of Engineering, Sinhgad Technical Education Society, Wadgaon budruk, Pune – 411 041, India

Biomass energy in China and its potential

[30] Biomass is a significant source of energy in China, particularly in rural areas. However, the use of firewood and agricultural residues for cooking and heating brings with it detrimental effects of indoor air pollution and associated adverse health impacts. In addition, the time spent collecting biomass fuels creates a burden on women and children, which reduces their time available for more productive activities. The availability of clean, low-cost fuels for heat and power in rural areas based on modern biomass technologies could significantly increase the living standards and would be helpful in promoting rural industrialization and generation of employment in rural areas. In addition, since sustainable use of biomass leads to no net increase in CO_2 emissions, there would be global climate benefits arising from the widespread use of biomass. This article discusses the size of the biomass resource base in China, the current status of modernized biomass technology development, and near- and mid-term commercial targets for implementation of modern bioenergy systems in China. This article also describes some advanced biomass conversion systems that might play a role in

Jingjing L, Xing Z, DeLaquil P, Larson E D. 2001
Energy for Sustainable Development **5**(4): 66–80

China's energy system in the longer-term. Finally, it describes current barriers and constraints on increasing the penetration of modernized biomass energy in China, along with some policy suggestions for addressing these. (4 figures, 11 tables, 29 references)

Asia Alternative Energy Programme, Energy & Mining Unit, East Asia and the Pacific Region, The World Bank, 172 Xizhimennic Avenue, 100 035 Beijing, China

Determination of reaction kinetics of straw and stalk of rapeseed using thermogravimetric analysis

[31] Agricultural residues can be used to generate energy through biochemical and thermochemical conversion processes. In this paper, TGA (thermogravimetric analysis) and DTA (differential thermal analysis) techniques were used to investigate the kinetics of thermochemical conversion of agricultural residues, namely the straw and stalk of rapeseed plants. The thermal degradation characteristics and kinetic parameters (order of reaction, activation energy, and pre-expanded factor) were determined using the TGA and DTA curves. TGA was performed at heating rates of 25, 50 and 100 °C per minute in an inert (nitrogen) atmosphere. DTA was performed at heating rates of 10, 30 and 50 °C per minute in a nitrogen atmosphere. Total degradation percentage and kinetic parameters were determined for the active zone where almost all of the thermal decomposition occurred. Total degradation in the active zone decreased with increasing heating rate. Total residual weight was lower (16%) when the heating rate was 25 °C per minute. These data will serve as a base for future pyrolysis experiments using the same raw material. (5 figures, 3 tables, 10 references)

Karaosmanoğlu F, Çift B D, and Işiğigür-Ergüdenler A. 2001
Energy Sources **23**(8): 767–774

Chemical-Metallurgical Engineering Department, Istanbul Technical University, 80626 Maslak, Istanbul, Turkey
<filiz@itu.edu.tr>

Relative reactivity of alkaline extracts of Taiwanese biomass residues toward formaldehyde

[32] The quantity of formaldehyde to phenolic mass in phenolic resin synthesis is one of the crucial factors affecting the characteristics of the final product. Thus, determining the quantity of formaldehyde absorbed by the extracts provides necessary and useful information for future resin formulation and synthesis involving biomass extracts. In this paper, six Taiwanese biomass materials, namely rice (*Oryza sativa L.*) hull, rice bran, sugar cane (*Saccharum officinarium L.*) bagasse, Taiwan acacia (*Acacia confusa Merr.*) bark, Taiwan acacia foliage, and Taiwan acacia leaf, were extracted with a 22% solution of sodium hydroxide at 95 °C for 16 hours and at an elevated temperature of 135 °C for 4 hours. These extracts were reacted with 44% formalin for 2 hours at 60 °C and 80 °C respectively, to investigate their reactivity towards formaldehyde. Extraction temperature, reaction temperature, and type of biomass material were found to significantly influence the reactivity of the extracts with formaldehyde. The 135 °C extracts of sugar cane bagasse absorbed the highest amount of formaldehyde while the 95 °C extracts of Taiwan acacia foliage absorbed the least amount of formaldehyde. (1 figure, 3 tables, 13 references)

Chen C-M and Liao T M-Y. 2001
Biomass and Bioenergy **20**(2): 133–139

School of Forest Resources, The University of Georgia, Athens, GA 30602, USA
<chen@smokey.forestry.uga.edu>

Characterization of the pyrolysis oil produced in the slow pyrolysis of sunflower-extracted bagasse

[33] The pyrolysis experiments of sunflower-extracted bagasse, for the production of pyrolytic oil, have been discussed in this paper. The experiments were carried out in a fixed-bed reactor

under self-pyrolysis and nitrogen atmospheres. The maximum oil yield of 23% was obtained at a final pyrolisis temperature of 550 °C with a particle size of 0.425–0.850 mm, with a heating rate of 7 °C/min, and nitrogen flow rate of 100 cm^3/min. The oil product was characterized by elemental analysis and various chromatographic and spectroscopic techniques and also compared with currently utilized transport fuels by simulated distillation and presented as a biofuel candidate. For the evaluation of the employment of pyrolytic oil as a fuel, the following options are recommended. (1) The liquid product may be used as a source of low-grade fuel directly or may be upgraded to higher quality liquid fuels. (2) Oil seems to be more appropriate for the production of hydrocarbons and chemicals. (3) The findings of laboratory-scale studies are encouraging and warrant larger-scale applications of biomass pyrolysis for synthetic fuels.
(5 figures, 6 tables, 24 references)

Yorgun S, Şensöz S, and Koçkar Ö. 2001
Biomass and Bioenergy **20**(2): 141–148

Department of Chemical Engineering,
Osmangazi University, 26480 Eskisehir, Turkey
<syorgun@ogu.edu.tr>

Hydropower and biomass as renewable energy sources in Turkey

[34] Hydropower and biomass are the most important and economical energy sources for Turkey. This study gives a review of production, consumption, and economics of hydropower and biomass as renewable energy sources of Turkey. Turkey has a total gross hydropower potential of 433 GW, but only 125 GW of the total hydroelectric potential of Turkey can be economically used. By the commissioning of new hydropower plants, which are under construction, 36% of the economically usable potential of the country would be tapped. The potential of important biomass energy sources and animal solid wastes are also determined in this study. Considering the total cereal products and fatty seed plants, approximately 50–60 million tonnes per year of biomass and 8–10 million tonnes of solid matter animal waste were produced, and 70% of the biomass can be used as a source for energy. Some of the useful recommendations made in the study are (1) development of advanced renewable energy technologies by the government, (2) due importance should be given to river type small hydroelectric power plants. (5 figures, 15 tables, 31 references)

Kaygusuz K. 2001
Energy Sources **23**: 775–799

Department of Chemistry, Karadeniz Technical
University, 61080 Trabzon, Turkey
<kaygusuz@ktu.edu.tr>

Biomass energy surveying and techno-economic assessment of suitable combined heat and power (CHP) system installations

[35] A general computer program has been developed and presented for the systematic assessment of the energy potential of various solid forms of biomass of a WGA (wide geographic area) and also of its interior zones which are selected by using relevant practical criteria. Based on the assessed biomass energy potential (after establishing a hierarchical order of the various solid biomass forms available) the program evaluates the technical feasibility and economic viability of identifiable CHP units which may be installed. An additional practical feature of the program is to form for the fuel supply of the CHP unit: either a mixed solid biomass fuel (by picking the right combination from the established energy preference order of the examined solid biomass forms) with steady annual contribution of the participating biomass residues; or a mixed solid biomass fuel which in

addition is based on priority of annual seasonal use of the available fuel residues in order to significantly reduce the associated storage cost. The application of the program (for illustrating purposes) has focused on a WGA. (with promising energy biomass potential) belonging to the North-east part of the Eastern Macedonia-Thrace Region of Greece, taking into consideration the pertinent energy and national development laws and other relevant factors. The simulation results pertaining to the examined WGA and its four interior zones demonstrated that it is possible, in terms of technical feasibility and economic viability, for interested investors to decide to install profitable CHP units. This becomes more attractive when the national subsidy on the required initial capital cost is secured the annual operating hours of the unit are relatively high the self-consumption level or the on-site electrical load supplied is high, and the cost per tonne of mixed solid biomass fuel is reasonable and stays relatively stable. Naturally, the installation and operation of a good-quality CHP unit using solid biomass as fuel, even in the worst case does not aggravate the well-known greenhouse gas problem, whereas at the same time it contributes positively to the development of the local and national economy. (11 figures, 9 tables, 19 references)

Papadopoulos D P and Katsigiannis P A. 2002
Biomass and Bioenergy **22**(2): 105–124

Electrical Machines Laboratory/Energy Systems Sections, Department of Electrical and Computer Engineering, Democritos University of Thrace, 671 00 Xanthi, Greece

[36]

Bioproductivity and nutrient cycling in bamboo and acacia plantation forests

Multipurpose tree species are extensively raised to meet the increasing demands for fuel and industrial wood and have assumed much importance due to successful afforestation of the barren areas in the country. To assess the growth performances of a species, it is important to study the productivity and nutrient dynamics. This study was mainly aimed to investigate the bioproductivity and nutrient cycling process in bamboo and acacia. The bioproductivity studies of bamboo showed that the total biomass increased with age (2.2 t/ha in year 1) up to six years (297.8 t/ha in year 6) and then decreased (15.6 t/ha in year 10). With acacia, the total biomass increased (1.8 t/ha in year 1 to 5.0 t/ha in year 3 and 10.9 t/ha in year 5). (27 references)

Shanmughavel P and Francis K. 2001
Bioresource Technology **80**(1): 45–48

Department of Botany, Bharathiar University, Coimbatore – 641 046, India
<shanvel_99@yahoo.com>

Wood energy

[37]

Village resource development as an incentive to sustain the joint forest management programme

Several studies have suggested that village resource development is necessary for sustaining the JFM (joint forest management) programme. Though JFM provides village people with various forest usufruct such as fuelwood, fodder, non-wood forest produce and a share in the final timber harvest in varying proportions as an incentive for forest protection, this is insufficient in itself to enhance the local communities' income levels, and reduce forest dependency. Recently, lot of efforts have been made in community development, initiation of income-generating schemes, and providing people with employment and wage earning opportunities. These have led to decreased forest dependency and to sustain the JFM programme. This paper reviews the role that village development has to play in JFM programmes and explores ways to make such activities sustainable. (1 figure, 3 tables, 11 references)

Wood Energy

Sethi P and Singh T P. 2001
The Indian Forester **127**(11): 1215–1222

Forestry and Biodiversity Group, TERI, Habitat Place, Lodhi Road, New Delhi – 110 003, India