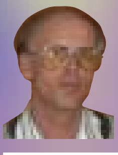
PyNe



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September 2002 ISSUE 14

Ensyn Announces Commissioning of new Biomass Facility

By Barry Freel, Ensyn Technologies Inc., Canada

Ensyn Group Inc., announced in February 2002 that it had commissioned a new 45 ton per day (dry basis) pyrolysis facility, increasing its overall capacity to greater than 110 tons per day (dry basis).

Commercial operation has now commenced for this new RTP™ expansion, converting wood into liquid bio-oil for the production of a number of specialty and other chemicals as well as fuels. This expansion will meet increased customer demand for Ensyn's natural chemical products, including polymer and co-polymer products for industrial use, natural chemical products for the food industry, carbon, and bio-oil renewable energy products. Ensyn's bio-oil production capacity now exceeds 5 million gallons per year, consolidating its lead in the pyrolysis industry.

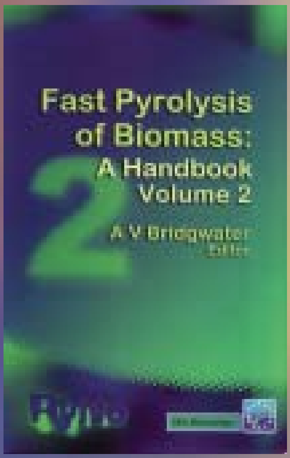
In addition to expanding its processing capacity, Ensyn anticipates continued addition to its proprietary refining capacity. The refining operations convert in-house produced bio-oil into a number of natural chemical and products. A new refining facility was commissioned in 2001 and is currently producing a range of polymer and co-polymer products to meet commercial demand, including a pyrolytic, sulfur-free lignin product. At full capacity, this first unit will produce in excess of 3,000,000 lbs per year of specialty chemicals including Ensyn's natural resin products.

Continued on page 2...........

Figure 1: RTP™ 45 ton/day Wood Pyrolysis Plant.

ENSYN

Fast Pyrolysis of Biomass



Fast Pyrolysis of Biomass: A Handbook Volume 2
A V Bridgwater Editor

Further details on page 2.

Comments and contributions are most welcome on any aspect of the contents.
Please contact your country representative for further details or send material to Claire Humphreys.

Contents

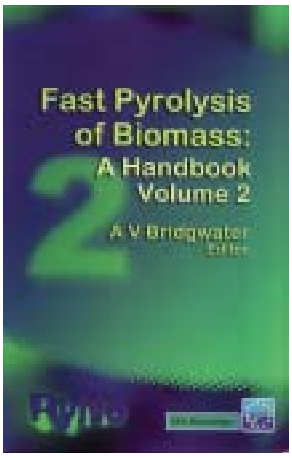
……. Continued from page 1

Mr. Barry Freel, Ensyn's Vice President and Chief Technology Officer, commented “The new capacity reflects a new generation of RTP™ technology with enhanced processing efficiencies and design. We are very pleased with its performance”. The facilities are capable of running 24 hours a day, 7 days a week, at more than 95% availability. Ensyn intends to continue expanding its RTP™ pyrolysis capacity, in step with the development and expansion of markets for its pyrolysis-based natural chemical and energy products.

Ensyn has operated its commercial pyrolysis facilities continuously since 1989. Until 1996, the Company’s focus was on scaling up the technology, the efficient production of consistent quality commercial quantities of pyrolysis intermediary products (bio-oil, char), and the production of food products. Since the commissioning their first 40+ ton per day (dry basis) plant in 1996, the focus has shifted to expanding the number of it’s commercial products derived from these pyrolysis intermediaries, and the introduction of these products to industrial markets. Through the production and marketing of these high value chemicals Ensyn can afford to provide energy at marketable prices. Ensyn believes that pyrolysis represents the foundation of a new bio-refining industry, comparable to the early days of petrochemicals, and the key to success lies in developing an array of profitable commercial pyrolysis products which can underpin a profitable expansion of pyrolysis production capacity.

For further details contact:

Barry Freel or David Boulard
Ensyn
2 Gurdwara Road
Suite 210
Ottawa, Ontario
Canada, K2E 1A2
Tel: +1 613 248 2257
Fax: +1 613 248 2260



Fast Pyrolysis of Biomass: A Handbook Volume 2

Edited by A V Bridgwater

This handbook is an edited version of the final report of the European Commission and IEA Bioenergy sponsored Pyrolysis Network that officially finished is 2001. It provides a companion volume to the first handbook published in 1999 and it is again intended that this will provide a useful guide both to newcomers to the subject area as well as those already involved in research, development and implementation.
A significant feature of this second volume is the greater attention paid to addressing commercial issues such as marketability, transportation and safety.

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Co-ordinator
Tony Bridgwater

Newsletter & Website Administrator
Claire Humphreys

Events Organiser
Julie Ellen

Bio-Energy Research Group,
Aston University, Birmingham B4 7ET.
UNITED KINGDOM.
Tel +44 121 359 3611
Fax +44 121 359 6814

Email a.v.bridgwater@aston.ac.uk
c.l.humphreys@aston.ac.uk
j.ellen@aston.ac.uk

Website http://www.pyne.co.uk

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The National Renewable Energy Laboratory (NREL)

By Stefan Czernik, NREL, USA

The National Renewable Energy Laboratory (NREL), will be celebrating 25 years of Research Excellence in July this year. It was originally called the Solar Energy Research Institute, which began operating in July 1977 and was designated a national laboratory of the U.S. Department of Energy (DOE) in September 1991. NREL's mission is to develop renewable energy and energy efficiency technologies; advance related science and engineering; and transfer knowledge and innovations to address the nation's energy and environmental goals. NREL's scientific areas include basic energy research; photovoltaics; wind energy; bioenergy; building technologies; advanced vehicle technologies; solar thermal electric; hydrogen; superconductivity; geothermal power and distributed energy resources.

Figure 1: Molecular Beam Mass Spectrometer.

The thermo-chemical conversion of renewable energy feedstocks has been investigated at NREL for more than two decades. The research in that field, sponsored by U.S. DOE Biomass Power, Biofuels, and Hydrogen Programs as well as by private companies, has been carried out in the Chemistry for Bio Energy Systems Center, which has recently become a part of National Bioenergy Center. Both fundamental and applied studies are conducted at the process scale ranging from micro-reactor to pilot plant.

Micro-scale pyrolysis systems include externally heated different types reactors coupled to the molecular-beam mass-spectrometer (MBMS) (Figure 1). These systems are very efficient tools, especially for studying mechanisms of thermal and catalytic processes and to optimize process conditions for different products from a variety of feedstocks. For example, the ongoing research sponsored by Philip Morris resulted in understanding the chemical processes of biopolymer pyrolysis and oxidation leading to aromatic hydrocarbon formation.

Figure 2: 20kg/h Fluidized Bed Reactor.

The NREL Thermo-Chemical Users Facility (TCUF) used for converting renewable feedstocks into a variety of products, including electricity, chemicals, hydrogen, and other fuels was described previously in PyNe Newsletter (Issue 12, page 5). The TCUF can be configured to accommodate the testing and development of various reactors, filters, catalysts, or other unit operations. Scales range from 0.1 kg/h for bench-scale reactors to 20 kg/h in the Thermo-Chemical Process Development Unit (TCPDU) (Figure 2). All units have capabilities to analyse products on-line over a wide spectrum of chemical compositions using dedicated analytical instruments. The TCPDU's state-of-the-art process control system is interconnected with the analytical instruments' control computers to create a single integrated database. The on-line analytical instruments available for characterising the conversion products are: molecular beam mass spectrometer; Fourier-transform infra-red spectrometer; non-dispersed infra-red spectrometer; rapid gas chromatographs, and other analyzers.

TCUF also includes electric power generation systems coupled to a 15kW spark ignition engine (Ford), (Figure 3) and a 30 kW micro turbine (Capstone) that uses biomass pyrolysis gas generated in the TCPDU.

Figure 3: 15 kW Ford Engine Generator.

For further information contact:

Dr. Stefan Czernik NREL
NREL
1617 Cole Blvd.,
Golden, CO 80401
USA
Tel: +1 303-384-7703
Fax: +1 303-384-6363
Email: Stefan_Czernik@nrel.gov

OR

Dr. Robert Evans
1617 Cole Blvd
Golden, CO 80401
USA
Tel: +1 303-384-6284
Fax: +1 303-384-6363
Email: Robert_Evans@nrel.gov

Global Markets and Technologies for Torrefied Wood in 2002

By James R. Arcate: Transnational Technology LLC, USA

Electric utilities are considering co-firing renewable fuels such as waste wood or biomass energy crops as a low cost option for reducing greenhouse gas emissions. Transnational Technology proposes co-firing Torrefied Wood, which is an intermediate product between wood & charcoal.

What is Torrefied Wood?

Torrefied Wood (TW) is made by mild pyrolysis of biomass at temperatures of 240ºC to 270ºC and the process is known as Torrefaction. The product has a stable moisture content of approximately 3%, a reduction of mass by 20 to 30% (primarily by release of water, carbon oxides, and volatiles) while retaining up to 90% of the wood's original energy content. The characteristics are shown in Table 1. TW is not a new product. In the 1980s the French developed industrial equipment for producing torrefied wood as a substitute for conventional charcoal and continue work on torrefied wood today; using it in building materials they call Retified Wood (1). Heat-treated wood is also produced as ThermoWood in Finland (2).

Species	Maritime Pine	Chestnut & Oak	Eucalyptus
Torrefaction results			
Temperature reached, ºC	280	270	275
Yield (on bone dry wood)*	77%	77%	74%
Elemental analysis			
C %	59.7	56.8	57.2
H %	5.6	5.2	5.1
N %	0.25	0.45	0.15
O %	32.9	36.2	37.2
Low CV of dry wood, kJ/kg	19,150	17,850	18,550
Low CV of TW, kJ/kg	22,600	21,500	22,650
Energetic yield %	90.8	92.7	90.3

Table 1. Characteristics of some torrefied woods.

Co-firing Torrefied Wood with Coal

Transnational Technology proposes co-firing torrefied wood with coal in pulverized coal boilers. This allows the energy in biomass to be converted to electricity with the high efficiency of a modern coal-fired power plant as well as reducing sulfur dioxide (SO_2) and net emissions of CO_2. TW is friable and can be blended with coal in the fuel yard, transported to the boiler via the coal handling system, pulverized and co-fired with the coal.

The heating value of TW is close to the average for steam coal and TW has less moisture than coals used for power generation. The power plant heat rate may actually be improved by co-firing with coal. TW could also be co-fired at higher percentages than raw biomass and separate biomass feed and firing systems would not be required.

Essent Energie, a power company in the Netherlands, is actively involved in direct co-firing a wide range of biomass fuels in their pulverized coal power plants. If torrefied wood can be co-pulverized with steam coal in unmodified pulverizers, at higher fuel mix percentages and at competitive biomass costs, there could be a substantial market opportunity for TW in the power generation sector. A government funded demonstration program is currently underway to produce approximately 30 tonnes of TW and test co-firing at one of Essent's pulverized coal power plants.

TW for Biomass-only Power Plants

Why bother making TW for biomass power plants? Why not just burn green wood chips? Using TW rather than wet wood in a typical 10 MWe wood fired power plant would increase efficiency from about 20% to 24%.

Torrefied wood pellets

The heat content of torrefied wood pellets is about 22.5 MJ/kg compared with 19.3 MJ/kg for conventional pine wood pellets. TW pellets have a volume energy density of about 18 GJ/m^3, approximately 20% higher than conventional wood pellets and about equal to steam coal at an average 20 MJ/kg.
The higher energy density of TW pellets compared to sawdust, wood chips and conventional wood pellets, would reduce transport costs and facilitate higher rates of TW co-firing with coal at PC power plants. The cement industry represents another potential large application for co-firing densified TW with coal. Torrefied wood could also be blended with biomass feedstock used for production of wood pellets and briquettes.

Figure 1: Shasta Power Plant, Anderson, CA (Warren Gretz-NREL).

Technologies for Manufacturing TW

The chemistry of torrefaction is influenced by many parameters, including biomass composition; particle size; processing temperature and time; heating rate; and off-gas composition, pressure and flow rate. In the temperature range of 220ºC to 280ºC, the major decomposition reactions concern hemicellulose. Cellulose and lignin undergo can also undergo polymer restructuring and depolymerization reactions, but to a lesser degree and Lipinsky (3) has discussed the chemical reaction mechanisms and kinetics that are at the foundation of torrefaction.

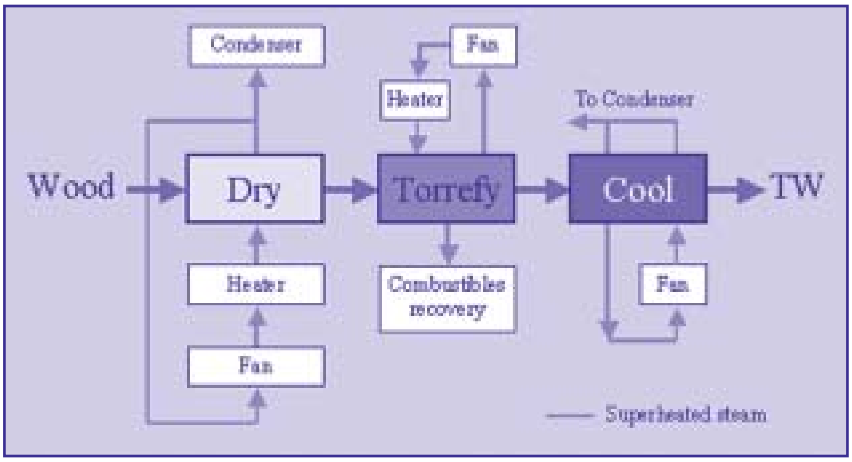


Figure 2: Continous superheated steam drying & torrefaction of wood.

Because water can play a significant role in torrefaction, the effects of using superheated steam have been explored. Superheated steam has a higher heat capacity than hot air or nitrogen and steam provides an airless processing environment that reduces losses from oxidation. Heat-Win Ltd. in the UK, has developed a technology known as Airless Drying (4), which uses superheated steam at atmospheric pressure to dry and torrefy wood (see Figure 2). Steam generated from the moisture removed by drying is vented and can be used for energy recovery. This process takes the technology a step further than just drying by heating the dried wood or biomass to around 270ºC when it is torrefied, or to 300ºC and higher for carbonization.

- The recirculating superheated steam atmosphere in the dryer is generated from the moisture removed from the wood by drying. The latent heat in steam vented from the dryer can be recovered by using an air or water-cooled condenser to produce hot air for pre-drying wood or hot water for space heating.
- Steam and wood gases generated by torrefaction are recirculated through the indirect heater and the torrefying chamber. Excess steam is condensed and combustible off gases can be used to produce heat for the process.
- To prevent self-ignition on contact with ambient air, the Torrefied Wood is cooled to a safe unloading temperature by recirculating superheated steam maintained at around 110°C.

TW Commercialization

A major challenge for torrefied wood plant developers is the availability of commercial equipment that will reduce the processing time, energy inputs and production costs for manufacturing bulk TW to acceptable levels. The superheated steam drying and torrefaction process discussed in this paper is a prime candidate for meeting this challenge.

Costs for production of TW are currently being established and will generally vary with the costs of the feedstock for TW and its particle size and moisture content.

For further information please contact:

James R. Arcate
Transnational Technology LLC
3447 Pipa Place
Honolulu, HI 96822-1221
Tel: +1 (808) 741 7502
Email: arcate@msm.com
Website: http://www.techtp.com

1, http://www.techtp.com/NOW.htm
2, http:/www.thermowood.fi/
3, Lipinski et al., "Enhanced Wood Fuels via Torrefaction", Fuel Chemistry Preprints, Volume 47, Number 1, Paper 171, Spring 2002. The paper is available on Transnational technology's web site: http:/www.techtp.com
4, http:/www.dryers-airless.mcmail.com/

Low Temperature Fast Pyrolysis of Lignocellulose

By Dr Branko Hermescec and David Butt, University of Melbourne, Australia

Project History

The idea was born in 1994 and evolved from research conducted on high temperature drying of woodflake in particleboard manufacture. It was found that under certain conditions within high temperature dryers, a partial mass reduction in the wood occurred which was not attributable to moisture loss. It was demonstrated that pyrolysis was occurring, albeit at temperatures below that which combustion occurs and considerably below those employed in conventional pyrolysis applications. Bench scale, batch type pyrolysis experiments were conducted to further characterise the phenomenon. Analysis of the products demonstrated that the liquid phase contained, amongst other things, a high yield of phenolic compounds.

Figure 1: Process Development Unit.

In order to overcome the problem of extensive degradation of the solid residue, fast pyrolysis, as opposed to batch type slow pyrolysis, of finely divided wood was attempted under similar conditions on a bench scale unit. The thermal stability of the major components in wood is, in decreasing order:

Cellulose > Lignin > Hemicellulose

Phenolic compounds are associated with the degradation of the lignin component. Therefore, a two-stage fast pyrolysis process was developed. The first stage was low temperature treatment of finely divided wood and involved the degradation of the hemicellulose component, yielding a liquid product rich in furan derivatives and a solid residue that was predominantly lignin and cellulose. The second stage was a higher temperature treatment of the solid residue obtained from the first stage and yielded a liquid product rich in phenolic compounds and a solid residue that was composed mainly of cellulose.

A process development unit (known as Big Bertha), capable of processing up to 5 kg of feed material/hour was designed and constructed between 1999 and 2001 (see Figure 1). The purpose of the unit is to provide sufficient quantities of each product for further evaluation as well as to investigate the effect of scaling on the process.

Process Description

The process is characterised by high rates of heating at relatively low reaction temperatures. The fast pyrolysis is carried out in a fluidised bed. In this apparatus, sand in the reactor is heated to the pyrolysis temperature. Upon contact with the hot sand bed, the feedstock is pyrolysed virtually instantaneously. The fluidising gas transports the pyrolysis products and solid residues to a product collection system before further degradation reactions occur. The product collection system includes a solid residue collector, quench column and an electrostatic precipitator.

A bench scale unit was first constructed to investigate and optimise the effect of certain operational parameters on the yield of phenols, furans and on the quality of the cellulose residue. Optimum conditions would produce a product that is abnormally rich in a small number of simple phenols, such as guaiacol.

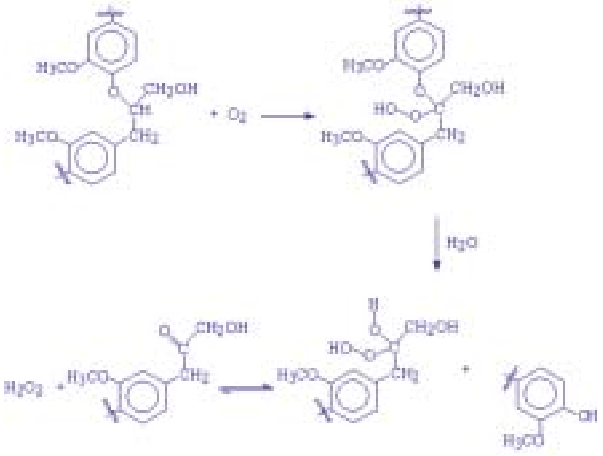


Figure 2: Cleavage of the aryl ether linkage (α or ß) by formation of an unstable peroxide with oxygen and subsequent reaction with a water.

It was found from the bench scale studies that oxygen, present within the reaction atmosphere, participated in and promoted certain degradation reactions, such as cleavage of the aryl ether linkage, the reaction diagram of which is shown in Figure 2. The effect of oxygen on the yield of the dominant phenolic compounds is shown in Figure 3.

The products of pyrolysis conducted under the conditions developed at the University of Melbourne are inherently less complex and more stable than their conventional counterparts and therefore such a pathway for the derivation of phenolic compounds seems more feasible.

Furfuryl alcohol has long been used in the production of strong, durable high quality resins. It is currently derived from the hydrogenation of furfural, which is in turn derived from the acid hydrolysis of agricultural residues. The composition of the product is shown in the chromatogram in Figure 4 and, for comparative purposes, a chromatogram of commercial grade furfuryl alcohol is shown in Figure 5. To demonstrate the selectivity of the process towards a specific degradation pathway, a chromatogram of a typical pyrolysis oil is shown in Figure 6, in which numerous degradation pathways are involved.

For further information please contact:

Dr Branko Hermescec
University of Melbourne
School of Forestry
Water Street
Creswick
Vic 3363
Australia
Tel: +61 3 5345 2927 and +61 2 4627 9880
Fax: +61 3 5345 2927 and +61 2 4627 9880
Email: buka@tpg.com.au

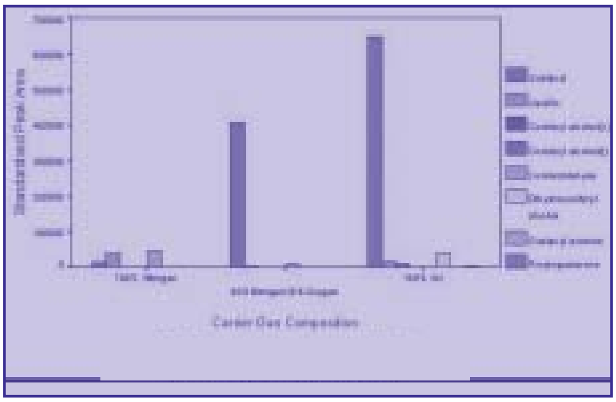


Figure 3: Effect of carrier gas composition on yield of phenols associated with aryl ether cleavage for oven-dried feed.

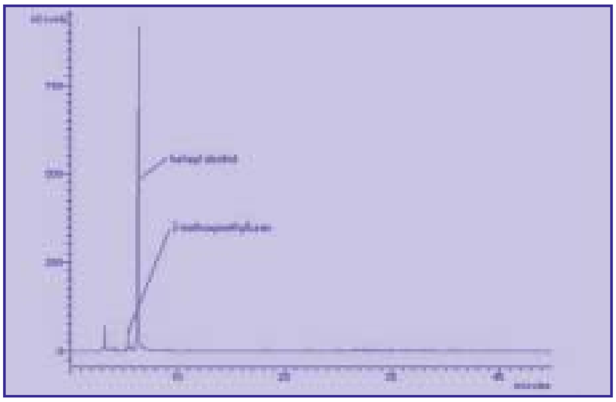


Figure 4: Chromatogram of product from low temperature fast pyrolysis of Radiata pine.

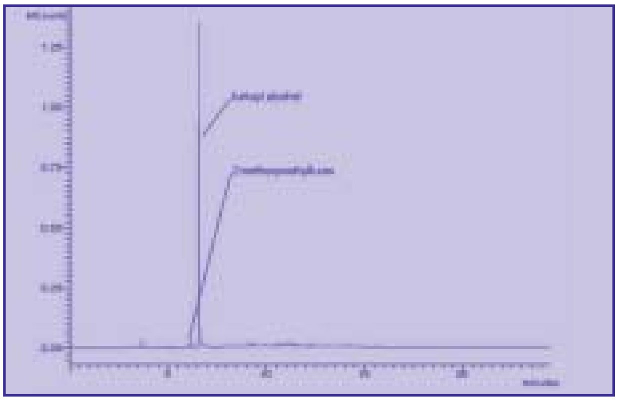


Figure 5: Chromatogram of commercial grade furfuryl alcohol.

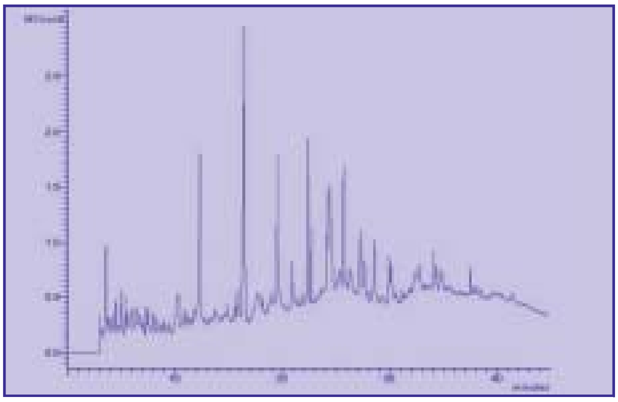


Figure 6: Chromatogram of a typical pyrolysis oil.

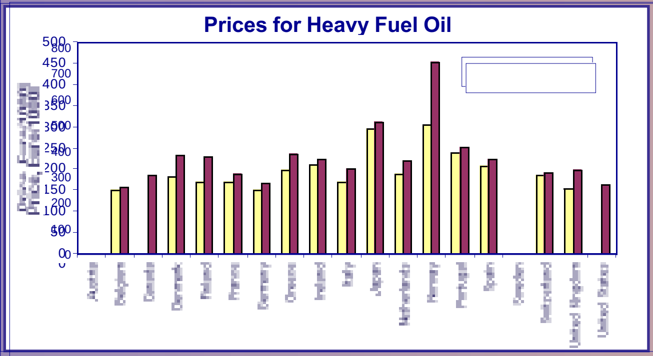
Energy

*By John Brammer, Bio-Energy Research Group,
Aston University, UK*

Fuel Oils

Country	***Heavy Fuel Oil***			***Light Fuel Oil (Industry)***			***Light Fuel Oil (Domestic)***		
	ex-tax	tax	total	ex-tax	tax	total	ex-tax	tax	total
Austria							269	145	414
Belgium	151	6	157	258	14	272	258	71	329
Canada			184			232	349	39	388
Denmark	182	52	234	362	33	395	331	427	758
Finland	171	57	228	261	68	329	261	140	401
France	171	19	190	261	41	302	293	106	399
Germany	150	18	168	260	61	321	260	113	373
Greece	198	38	236	268	157	425	269	233	502
Ireland	210	14	224	284	47	331	349	97	446
Italy	170	31	201	316	367	683	316	503	819
Japan	295	15	310	279	14	293			
Netherlands	188	31	219				327	282	609
Norway	305	148	453	412	107	519	430	236	666
Portugal	240	12	252						
Spain	209	13	222	258	79	337	258	132	390
Sweden				247	58	305	280	369	649
Switzerland	185	7	192	250	7	257	278	29	307
United Kingdom	154	44	198	236	50	286	244	65	309
United States			165			223			382

Heavy fuel oil is low sulphur, except Canada, Ireland, UK and US (high sulphur)
Heavy fuel oil density 0.97 kg/l



Average prices over 2001, except *2000, **1999.

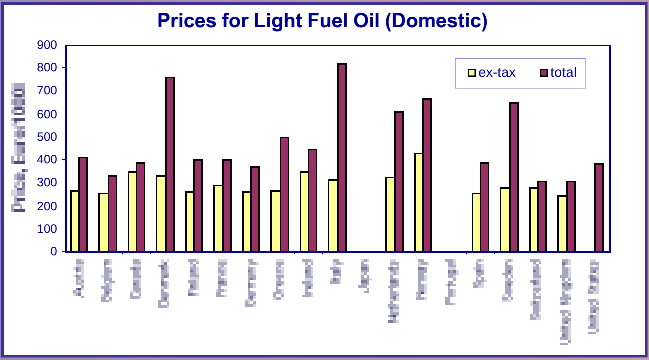
All liquid fuel prices in Euro per 1000 litres.

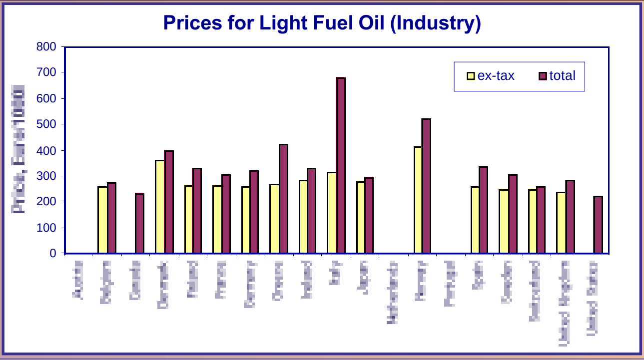
All gas and electricity prices in Euro per 100 kWh (or cents per kWh), gas on GCV basis.

All currency conversions based on exchange rates only 1 Euro = 0.895 US$

Principal source:
IEA energy Prices & Taxes, 2nd Quarter 2002 (ISSN 0256-2332)

Brazil omitted as no data available.



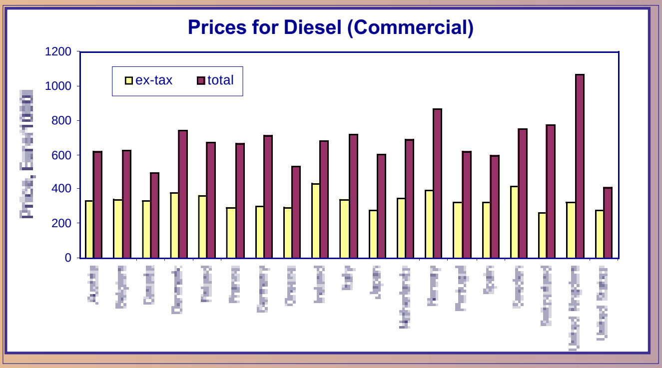


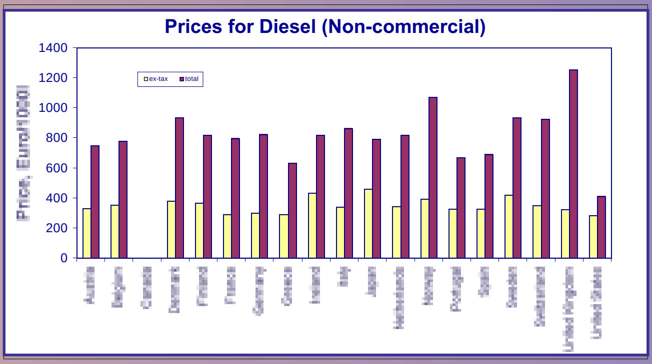
Prices & Taxes 2001

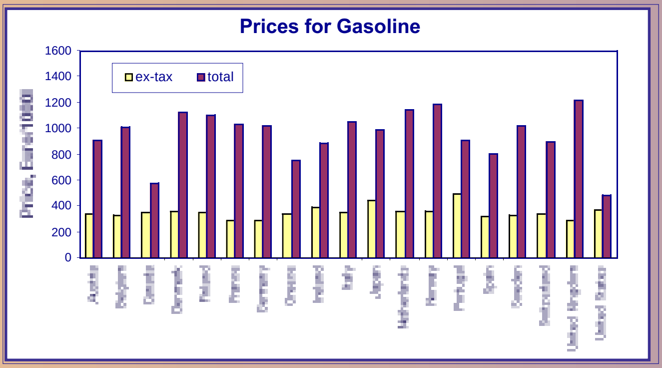
Transport Fuels

Country	Diesel (Commercial)			Diesel (Non-commercial)				Gasoline	
	ex-tax	tax	total	ex-tax	tax	total	ex-tax	tax	total
Austria	333	290	623	333	415	748	338	566	904
Belgium	339	290	629	355	426	781	326	682	1008
Canada	336	161	497				348	226	574
Denmark	383	363	746	383	550	933	364	757	1121
Finland	367	304	671	367	452	819	350	759	1109
France	293	374	667	293	506	799	294	742	1036
Germany	300	409	709	300	522	822	289	735	1024
Greece	293	244	537	293	341	634	343	411	754
Ireland	434	249	683	434	386	820	393	496	889
Italy	340	382	722	340	526	866	356	695	1051
Japan	281	324	605	459	333	792	448	541	989
Netherlands	347	342	689	346	474	820	358	790	1148
Norway	396	470	866	396	677	1073	366	824	1190
Portugal	326	295	621	326	343	669	491	422	913
Spain	327	270	597	327	366	693	324	483	807
Sweden	419	329	748	419	515	934	331	690	1021
Switzerland	263	508	771	352	575	927	339	556	895
United Kingdom	322	745	1067	322	932	1254	291	929	1220
United States	282	132	414	282	132	414	376	113	489

Gasoline is premium unleaded 95 RON, except Canada (97 RON), Denmark (98 RON) and Japan (Regular)

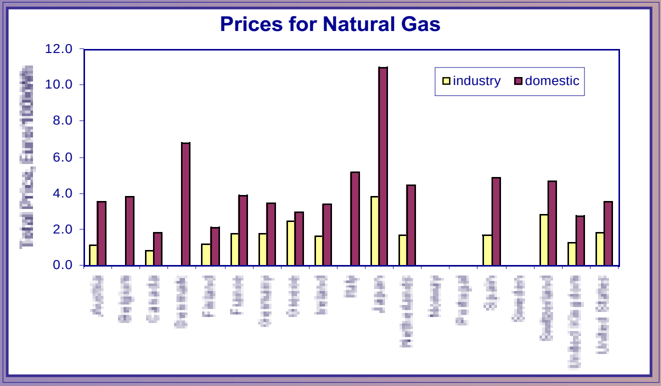






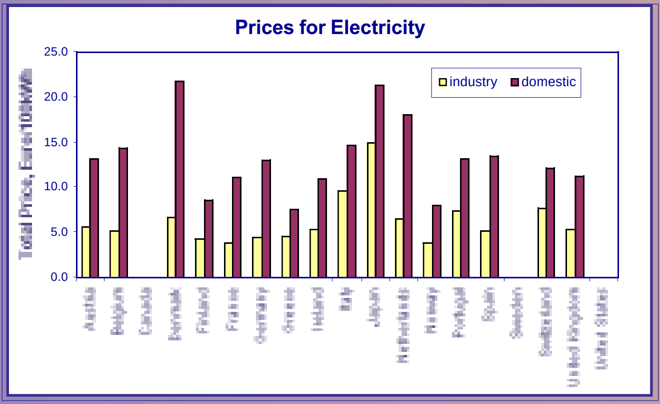
Gas

Country	Natural Gas (Industry)			Natural Gas (Domestic)		
	ex-tax	tax	total	ex-tax	tax	total
Austria	1.17**		1.17**	2.58	0.96	3.54
Belgium				3.02*	0.78*	3.80*
Canada			0.83*			1.84*
Denmark				2.93	3.88	6.81
Finland	1.05	0.16	1.21	1.58	0.54	2.12
France	1.80		1.80	3.29	0.65	3.94
Germany	1.53*	0.22*	1.75*	2.65*	0.83*	3.48*
Greece	2.46		2.46	2.75	0.22	2.97
Ireland	1.64		1.64	3.01	0.38	3.39
Italy				2.76**	2.39**	5.15**
Japan	3.67*	0.18*	3.85*	10.50*	0.53*	11.03*
Netherlands	1.60	0.09	1.69	2.40	2.04	4.44
Norway						
Portugal						
Spain	1.69		1.69	4.21	0.67	4.88
Sweden						
Switzerland	2.81	0.02	2.83	4.36	0.35	4.71
United Kingdom	1.28		1.28	2.62	0.13	2.75
United States			1.85			3.55



Electricity

Country	Electricity (Industry)			Electricity (Domestic)		
	ex-tax	tax	total	ex-tax	tax	total
Austria	5.56**		5.56**	9.48*	3.69*	13.17*
Belgium	5.18*		5.18*	11.72*	2.63*	14.35*
Canada						
Denmark	5.64	1.02	6.66	8.50	13.28	21.78
Finland	3.83	0.43	4.26	6.34	2.25	8.59
France	3.88*		3.88*	8.70*	2.33*	11.03*
Germany	4.40*		4.40*	11.29*	1.80*	13.09*
Greece	4.52*		4.52*	7.01*	0.56*	7.57*
Ireland	5.31*		5.31*	9.78*	1.22*	11.00*
Italy	8.18*	1.47*	9.65*	11.34*	3.36*	14.70*
Japan	13.81**	1.12**	14.93**	19.82*	1.42*	21.24*
Netherlands	5.93	0.62	6.55	9.31	8.71	18.02
Norway	3.07	0.74	3.81	4.98	2.94	7.92
Portugal	7.36		7.36	12.51	0.63	13.14
Spain	4.98**	0.25**	5.23**	11.02**	2.42**	13.44**
Sweden						
Switzerland	7.72		7.72	11.31	0.86	12.17
United Kingdom	5.38		5.38	10.72	0.53	11.25
United States	4.75			9.47		



Diary of Events

Information compiled by Claire Humphreys, Aston University, UK

China Hi-Tech Fair/Environment & New Energy 2002
Venue: Shenzhen, P.R. China
Date: 12-17 October 2002
Contact: Coastal International Exhibition Co, Ltd.
Tel: +852 2827 6766
Fax: +852 2827 6870
Email: general@coastal.com.hk

Reactor Engineering for Biomass Feedstocks – 2002 Annual AIChE Meeting
Venue: Indianapolis, Indiana
Date: 3-8 November 2002
Contact: Chair – Michael J. Antal, Jr.
University of Hawaii
Hawaii Natural Energy Institute
2540 Dole St.,Honolulu,
HI 96822 USA
Tel: +1 808-956-7267
Fax: +1 808-956-2336
Email: mantal@hawaii.edu
Website: http://www.aiche.org/annual/

OR

Co-Chair – Galen Suppes
University of Missouri-Columbia
Dept. of Chemical Engineering
W2028 Engineering Building East
Columbia, MO 65211
Tel: +1 573-884-0562
Fax: +1 573-884-4940
Email: suppesg@missouri.edu
Website: http://www.aiche.org/annual/

2nd Regional Conference on Energy Technology towards a Clean Environment Deadline for abstract submission: 15 October 2002
Venue: Phuket, Thailand
Date: 12-14 February 2003
Contact: RCETCE's Secretariat
King Mongkut's University of Technology Thonburi,
91 Pracha-uthit Road
Bangmod, Tungkru
10140, Thailand
Tel: +66 (0)2 470 8309/8310, Ext 4133/4
Fax: +66 (0)2 872 9805
Email: rcetce@jgsee.kmutt.ac.th
Website: http://www.jgsee.kmutt.ac.th/rcetce.html

URFRO – All Division 5 Conference
Venue: Rotorua, New Zealand
Date: 11-15 March 2003
Contact: John Stulen
Innovatek
PO Box 6160
Rotorua
New Zealand
Tel: +64 7 348 1039
Fax: +64 7 343 1420
Email: johnstulen@clear.net.nz
Website: http://www.forestresearch.co.nz/site.cfm/alldiv5iufronz

The World Sustainable Energy Exhibition & Conference
Venue: Amsterdam, The Netherlands
Date: 13-15 May 2003
Contact: Marc V Sterel
Product Manager Energy & Environment
Amsterdam RAI
PO Box 77777
NL-1078 MS
Amsterdam
Tel: +31 (0)20 549 1212
Fax: +31 (0)20 549 1843
Email: sustain2003@rai.nl
Website: http://www.sustain2003.com

Energy and the Environment 2003 First International Conference on Sustainable Energy, Planning & Technology in Relationship to the Environment
Venue: Halkidiki, Greece
Date: 14-16 May 2003
Contact: Gabriella Cossutta
Fax: +44 (0)238 029 2853
Email: gcossutta@wessex.ac.uk
Website: www.wessex.ac.uk/conferences/2003/energy2003/1.html

International Conference on Energy and the Environment
Venue: Shangliai, China
Date: 22-24 May 2003
Contact: Dr. Daoping Liu
Executive Secretary of ICEE 2003
University of Shanghai for Science and Technology
P.O. Box 224, No. 516
Jun Gong Road
Shanghai, 200093, China
Tel: +86-21-65689564; 86-21-65680843; 86-21-65671982
Fax: +86-21-65680843; 86-21-65692958
Email: dpliu@online.sh.cn

Bioenergy2003 International Nordic Bioenergy Conference and Exhibition
Venue: Jyväskylä Paviljonki, Finland
Date: 2-5 September 2003
Contact: Ms Mia Savolainen
FINBIO, PO Box 27
FIN-40101 Jyäskylä,
Finland
Tel: +358 14 445 1115/7
Fax: +358 14 445 1199
Email: bioenergia@jsp.fi
Website: http://www.gwu.edu/~eem/ICEE/committeesnew.htm

International Workshop on Pyrolysis and Bio-Oil

Bio-oil Production Opportunities for New Liquid Fuels and Chemicals through Research and Development

Date: 25–26 November 2002

Venue: CSIRO Ian Wark Laboratories,
Bayview Ave, Clayton, Victoria 3169, Australia

The workshop will bring together local and international researchers, investors and the fledgling bio-oil interests in Australia where there is excellent potential to develop a bio-oil industry. Overseas specialists can interact with Australian researchers and industry interests to identify opportunities for cooperation in research, development and implementation. This will lead to an international coalition of stakeholders to develop effective bio-oil industries.

Keynote Speaker:

Professor Tony Bridgwater, Coordinator of the International Pyrolysis and Gasification Network 'PyNe'

Workshop Areas:

1. Pyrolysis – Fast Pyrolysis, slow pyrolysis
2. Bio-oil – Properties
3. R&D and Markets

Enquiries:

Vanessa Dusting, CSIRO Forestry & Forest Products, Private Bag 10, Clayton South VIC 3169, Australia
Tel: +613 9545 2381
Fax: +613 9545 2448
Email: Vanessa.Dusting@csiro.au
Website: http://www.ffp.csiro.au/conference/bio_oil/

PyNe Membership

Please contact your country representative for further information.

Co-ordinator

Tony Bridgwater
Bio Energy Research Group
Aston University
Birmingham
B4 7ET
UNITED KINGDOM
Tel: +44 121 359 3611
Fax: +44 121 359 6814/4094
Email: a.v.bridgwater@aston.ac.uk

Austria

Maximilian Lauer
Institute of Energy Research
Joanneum Research
Elisabethstrasse 5
A-8010 Graz
AUSTRIA
Tel: +43 316 876 1336
Fax: +43 316 876 1320
Email: max.lauer@joanneum.at

Belgium

Yves Schenkel
Centre for Agricultural Research (CRA)
Chaussée de Namur, 146
Gembloux
B–5030
BELGIUM
Tel: +32 81 627148
Fax: +32 81 615847
Email: schenkel@cragx.fgov.be

Denmark

Karsten Pedersen
Danish Technological Institute
Julsoevej 6
DK-8600 Silkeborg
DENMARK
Tel: +45 8684 5822
Fax: +45 8684 5811
Email: kp@chemidan.dk

Finland

Anja Oasmaa
VTT Energy
New Energy Technologies
PO Box 1601
Espoo, FIN-02044 VTT
FINLAND
Tel: +358 9 456 5594
Fax: +358 9 460 493
Email: Anja.Oasmaa@vtt.fi

France

Philippe Girard
Cirad Forêt
Energy Environmental Unit
TA 10/16
73 Rue Jean Francois Breton
Montpellier Cedex 5
34398
FRANCE
Tel: +33 467 61 44 90
Fax: +33 467 61 65 15
Email: philippe.girard@cirad.fr

Germany

Dietrich Meier
BFH-Institute for Wood Chemistry
Leuschnerstrasse 91
D-21031 Hamburg
GERMANY
Tel: +49 40 739 62 517
Fax: +49 40 739 62 502
Email: d.meier@holz.uni-hamburg.de

Greece

Ioanna Papamichael
C.R.E.S. – Biomass Department
19th km Athinon Marathonos Ave
GR 190 09
Pikermi – Attikis
GREECE
Tel: +30 10 660 3389
Fax: +30 10 660 3301
Email: ioannap@cres.gr

Ireland

Seamus Hoyne
Irish Bio-Energy Association
c/o Tipperary Institute
Clonmel, Co.
Tipperary
IRELAND
Tel: +353 504 28472
Fax: +353 52 80442
Email: shoyne@tippinst.ie

Italy

Colomba Di Blasi
Universitá degli Studi di Napoli
'Federico II'
Dipartimento di Ingegneria Chimica
P. le V. Tecchio
80125 Napoli
ITALY
Tel: +39 081 768 2232
Fax: +39 081 239 1800
Email: diblasi@unina.it

Netherlands

Wolter Prins
BTG
Business & Science Park
Pantheon 12
PS Enschede
7521
NETHERLANDS
Tel: +31 53 486 2282
Fax: +31 53 432 5399
Email: w.prins@ct.utwente.nl

Norway

Morten Gronli
SINTEF Energy Research
Thermal Energy and Hydropower
7034 Trondheim
NORWAY
Tel: +47 73 59 37 25
Fax: +47 73 59 28 89
Email: Morten.Gronli@energy.sintef.no

Portugal

Filomena Pinto
INETI-ITE-DTC
Edificio J
Azinhaga dos Lameiro
Estrada do Paço do Lumiar
1699 Lisboa Codex
PORTUGAL
Tel: +351 1 716 52 99
Fax: +351 1 716 65 69
Email: Filomena.Pinto@ineti.pt

Spain

Jesus Arauzo
Universidad de Zaragoza
Chemical & Environmental Engineering
Department
Centro Politecnico Superior
María de Luna 3
E 50015 Zaragoza
SPAIN
Tel: +34 97 676 1878
Fax: +34 97 676 1879
Email: qtarauzo@posta.unizar.es

Sweden

Erik Rensfelt
TPS Termiska Processer AB
Studsvik
S-611 82 Nykoping
SWEDEN
Tel: +46 155 221385
Fax: +46 155 263052
Email: erik.rensfelt@tps.se

USA

Stefan Czernik
NREL
1617 Cole Boulevard
Golden, Colorado,
80401, USA
Tel: +1 303 384 7703
Fax: +1 303 384 6363
Email: Stefan_Czernik@NREL.Gov

PyNe and GasNet technical visit earlier this year

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For further details or offers to contribute, please contact Claire Humphreys (see inside front cover for details). Any opinions published are those of the contributors and do not reflect any policies of the EC or any other organisation. EoE

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