Biomass: Looking for a solution to Europe's overproduction problems

by Roger Samson

In October, the author attended the 7th European Conference on Biomass for Energy and Environment, Agriculture and Industry in Florence Italy. Europe's showcase for biomass researchers, it was an opportunity to examine what directions Europe is pursuing in industrial crop development. After the conference, Samson toured with biomass research groups to see if activities in the field showed as much promise as in the showroom.

Europe has a big problem: agriculture. Paradoxically, the crisis is one of too much farm production due to too much of the European Community budget going to farm subsidies. This situation has been exacerbated by pressure to re-new the GATT, a negotiation stymied by the dispute over grain markets between the U.S. and the EC, with the latest U.S. actions demanding subsidy reductions and access to EC oilseed markets. French farmers are rioting over the proposed solutions and the Americans have threatened trade sanctions if changes are not made. What to do . . . what to do?

The management of this crisis situation will have to be left to the politicians in the short-term. However, in the search for longer term solutions which have a real chance of resolving the conflict, there are two ways of looking at the situation:

1. The problem can be viewed as one of supply, with the result that land needs to be set aside to reduce production in order to resolve the conflict; in other words, put farmers on an agricultural version of unemployment insurance program for about one quarter of their land. Subsidies could be phased down gradually, with a similar percentage of farmers phased out in the medium term. Passive social assistance in the hope of making farmers more passive.

2. The second approach is to say that the problem is one of demand. If food markets are saturated, it becomes the time to search out alternatives, such as non-food markets, for agricultural production. The concept is called demand enhancement and is the rationale behind new industrial crop development strategies in Europe.

The biomass conference displayed over 350 industrial crop initiatives, everything from cheap fuel from Olive husks to clean bleaching of pulp from non-wood fibre plants. On the production side, one thing was clear: the only feedstock that was available commercially was forest residues. Several countries such as Austria and Sweden had made a significant contribution to their internal energy supply (approximately 10%) by using waste forest residues in community heating systems.

As far as farm derived feedstocks, there was work going on in four main areas:

1. Short Rotation Forestry, mostly coppicing fast growing trees;

2. Sweet Sorghum, an annual thick stemmed tropical row crop similar to corn;

3. Miscanthus, a C4 perennial reed from East Asia; and

4. 1740 C4 perennial reeds, from different regions around the world.

After listening to the different proponents of industrial crop development, one thing became clear: all is not well in Europe's biomass research programs. There was not one mention of the cost of producing biomass during the five days of the conference and the research from the three main networks was almost entirely focused on species which have requirements for productive soils. If there is a a 25% land set aside in Europe, farmers likely won't set aside their best land but their worst. To create a viable European biomass production program, researchers need to know at least the costs and work with species suitable for the targeted land base.

On the conversion end there were two major markets discussed:

1. Energy, for electricity/heat generation and liquid fuel production;

2. Fibre, for paper, timber, fibreboards, insulation, and fully degradable industry products and packaging materials.

Of these two, energy represents about 70% of the market potential. However, it appeared that the entry point for biomass was not as an energy feedstock but for higher value end products in the fibre markets. It appeared that farm derived biomass sources initially would displace wood rather than fossil fuels. The products produced would be items such as fibre boards, packaging and paper. The key to unlocking this potential market was the ability to produce a reasonably priced farm derived biomass source in Europe. If Europe cannot do it, other regions will do it for them.

The other thing that became clear was that biomass was going to have a difficult time penetrating energy markets in Europe for two reasons:

1. production capacity, with the lack of land base availability hindering opportunities to make a substantial contribution to conventional energy displacement; and

2. producing biomass at a competitive price (small farms and a heavily subsidized agricultural system do not lend themselves well to the production of abundant cheap biomass which is required to penetrate competitive energy markets).

Visiting Biomass Research in the Field

The first visit following the conference was to see Dr. Stander of the Polytechnical Institute in Munich, Germany and learn more about the 1740 C4 reeds he is evaluating, as well as his conversion technologies. Dr. Stander is an engineer by training who is attempting to put together a production and end-use package for the large scale commercialization of biomass. He believes very strongly that the production of C4 reeds is the biomass feedstock of the future.

In the past, according to Stander, biomass efforts have largely been a failure because of the wrong choice of plants and plant products. He promotes C4 reeds as they are the highest biomass producing plant genera in the world. There are a number of reasons for their productivity, but this is mostly due to their efficient light interception and conversion, along with low water and nitrogen requirements. They are also easier to handle because C4 reeds contain large quantities of lignocellulose, a polysugar which stores well. In comparison, sweet sorghum produces a sugar that doesn't store well. Stander believes the large scale production of lignocellulose through productive C4 reeds will, for the first time, enable large scale commercial biomass production.

Conversely, Stander contends that fast growing trees are not feasible due not only to complications involved in the harvesting and processing of wet materials, but primarily to poor light conversion efficiency and high water consumption of the trees which limits productivity. He also eliminates sweet sorghum and other annuals because of their high chemical input requirements, soil degrading properties, slow canopy closure, high moisture content at harvest and the need for immediate processing after harvest (because of rapid sugar transformation).

He initiated some of the first studies on Miscanthus in Europe in 1986 but now considers it only one of many potential C4 perennial reed species for biomass production. His present C4 grass program is evaluating species from temperate climates around the world, from North America to the Himalayan and Andes mountains. Some of the characteristics being evaluated in these grasses include: upright leaf architecture, long vegetative growth phase, and chilling tolerance. At the time of the conference in October, some of the test grasses transplanted in the spring of 1992 had reached a height of 3.5 metres.

Stander is also advanced in converting the various grasses to potential energy and fibre markets. He is developing several small power and heat generation devices to process the material into usable energy forms.

Central to this development is a "briquetting" device to compact grasses in order to lower biomass storage, handling and transportation costs. In the former East Germany, he has tried grass briquettes as a substitute for coal in home heating with good results.

He has also done significant research on the various fibre market opportunities with warm season grasses. The fibres of grasses provide strength and the pith provides excellent insulating properties. Some of the products manufactured to date include packing chips, french fry containers, paper plates, and various fibre boards suitable for house construction, insulation or even furniture building.

Stander is a controversial scientist in Germany who is getting a lot of media attention. A book by Franz Alt, a well respected author and TV journalist, has been recently published on Stander's research, entitled "C4 reeds vs. nuclear energy." Stander is definitely at the forefront of biomass developments in Europe; all his ideas may not be winners but he has enough of them that something is going to pan out sooner or later.

The next stop on the tour was to visit the Institute of Land and Forest Sciences in Bavaria where they are doing research on short rotation woody crops and Miscanthus. They have been emphasizing Miscanthus in their most recent work because of promising yields and because once land is put into trees (i.e. SRF) it cannot go back into agricultural production in Germany. The recent Miscanthus work has been focusing on fertility and variety tests.

The main objectives are to find productive types of Miscanthus which are winter hardy and to develop techniques to reduce plant propagation costs. The tests are showing that they can get approximately 20 t/ha of biomass. Some of the first field scale plantings of commercial Miscanthus are being made just over an hour north of Munich. The Miscanthus is being used as a power source, along with straw and wood chips, to supply power for a new forage dehydration plant.

The Miscanthus plantings were subsidized at a cost of approximately $8,000/ha and the farmers get approximately $100/tonne for the biomass delivered to the plant. The main problems in addition to the enormous capital outlay for the Miscanthus planting has been winter kill, with approximately 70% destruction of fields established in 1991.

The last stop in Germany was a visit to the Vervboel???? oil company near Dusseldorf. The company is one of the largest oil companies in Europe and is investing $30 million in Miscanthus research over a 5 year period. They have approximately 40 hectares of Miscanthus planted near the Rhine river on some of the best farmland in Europe. Originally the site was to be used for a conventional energy plant but environmental protests stopped plant construction. The growth of the grass was tremendous at this site with a yield estimate of approximately 25-28 t/ha. Some of the material grew 4 metres tall in a single season of growth.

The main problem being experienced is winter annual weeds which start growing before the Miscanthus in the spring. However, the most serious

problem in terms of conversion is the lack of dry down of the material prior to spring harvest of the over wintering material. For instance, in the spring of 1992, the material contained 40% moisture at the time of spring harvest when the next years growth resumed. This is a logistical nightmare if the material is not close to being dry at time of harvest and field drying is impossible because of the enormous volume of material and large size of the stem. It may be that thinner stemmed species are needed to obtain dry material. The oil company is looking at a variety of potential markets for the material including hydrogen production. They were one of the first companies to make wood alcohol during the second world war.

The remainder of the trip was spent in France looking at short rotation forestry, windbreaks and woody combustion systems which will be discussed in the upcoming Winter 1993 issue.

Summary

The take-home message from the trip was that C4 grasses have an enormous potential to meet society's energy and fibre needs in an ecologically sound way. The main problem to overcome is cost and it is clear that Europe does not have a comparative advantage when it comes to producing low cost biomass. The farms are generally small, with an average size of approximately 30 hectares. Even the road infrastructure isn't set up for handling big volumes of material.

Farmers in Europe believe they need at least $100/tonne to make an adequate living from biomass. There is no possible way that it can compete with conventional energy sources at this price. What to do? Probably it will take even larger public subsidies for these farmers to make a living from biomass than from grains.

For cheap biomass a lot of land is needed. The solution maybe for large agricultural exporting countries such as Australia, the U.S., Canada and Brazil, which have a significant land base for producing export cereals and oilseeds on marginal lands, should cut back production of these crops and produce biomass instead. Unlike Europe, all these areas have a large natural grassland area (composed of native C4 grass flora) with a relatively dry climate. The grasslands of the world that have been plowed up and put into wheat could be planted back into native grasses and processed into liquid fuels or compacted into briquettes and exported to Europe. Europe's relatively wet, cool climate gives it a comparative advantage in producing cereals. The long term solution to the overproduction problem may be for Canada to reduce the degree to which we are in the export grain business and get into the export biomass business because Europe won't be able to compete.