Four years ago in 1971 at your meeting in Portland, I presented a paper on our changing times with environment ecology and pollution in relationship to using your wood by-products (bark, sawdust, chips, shavings and slabs) for generating steam for your dry kilns, plant heating and electrical generation.

I told you in that paper that prices were increasing for energy and that if you used gas you had to be aware of the interruptable feature. In the greater Seattle area this year saw mills with gas fired boilers for their dry kilns were without gas for about 3 months.

I told you that it was predicted in talks by top industry personnel that we would have a tremendous increase in demand for electricity by the year 2000. At the same time I told you of talks predicting a population rise in the U.S. to 300,000,000 in the next 30 years. These predictions are proving to be very much on target.

One dry kiln man like yourselves who had a copy of my 1971 paper told me that he gave the report to his upper management to read. They told him that I was crazy, didn't know what I was talking about. Two years ago top management asked this chap if he still had that paper, they said I wasn't as crazy as they thought at the time, the figures and recommendations had merit. But that's par for the course. In this day and age you can get a lot of opposition to anything you say. I've also found out in my life span to date that it pays to be a little crazy.

In the past year "Energy" entered into the picture with the force of an atomic blast. This was a two fold blast, (1) skyrocketing costs and (2) availability. Isn't it interesting that within the past 4 years first with ecology and pollution and now energy that we are finding how valuable each piece of bark and each grain of sawdust is to our use as energy.

As we watched this develop and implement itself upon our economy we reread our paper of 1971 and felt that certain portions were of extreme value in reevaluating basic parts in relationship to energy and the dry kiln.

Let's take a look at some figures, remember these are general but they do reveal some facts that bear looking into. Probably most of the lumber companies using their wood wastes under their boilers realize the great savings is using these products. Many lumber companies without these facilities should study them very carefully, it could be an immense hidden asset. Really with fuel at no cost. Because you have already paid for the log of which the bark, sawdust etc. There are several companies manufacturing steam plants today that operate on wood waste that meet the new rigid state and federal laws for EPA. Now here is where the research relating to figures comes in. Remember these are not computerized, they are quite broad in their use but they bring out the hidden or unrealized potential of the wood waste use in the manner that we have been talking about.

Before going further, it might be well to put on the board some figures that will help you to understand more clearly the dollar value potential of wood by-products as a source of energy for your dry kilns.
Those of you who already have this system of energy will be able to get some idea as to your steam costs which of course will no doubt vary greatly depending upon the cost accounting system of your company.

Remember that our figures are average and they do vary from mill to mill, state to state and country to country. They do however give you a good base to work with. Following are the unit figures that we use in our computations.

1 Boiler horse power = 33,472 BTU/hour
1 Boiler horse power = 34.5 lb of steam/hour from and at 212°F - 15.65 kilograms of steam/hour
1 Boiler horse power = 10.1 kilowatts/hour
Bunker Oil = 152,000 BTU/Gal = 40,158 BTU/Liter
P. S. 300 Oil = 149,000 BTU/Gal = 39,366 BTU/Liter
Diesel Oil = 148,000 BTU/Gal = 39,101 BTU/Liter
1 Thermgas = 100,000 BTU
Propane = 92,000 BTU/Liter

Note that we have included the conversion from Centigrade to Fahrenheit and from Fahrenheit to Centigrade. More and more people ask about this so I thought it would be good to include it.

32° Fahrenheit = 0° Centigrade
212° Fahrenheit = 100° Centigrade

(° Centigrade x 9) + 32 = ° Fahrenheit

5

(° Fahrenheit - 32) x 5 = ° Centigrade

Most generally the following is used:

200 Cubic Feet Bark - 5.66 Cubic Meters
1 (unit) Hog Fuel - 4500 lbs/unit - 4500 BTU/lbs.

2041 Kilograms/Unit 9,921 BTU/Kilogram
20,250,000 BTU/200 Cubic Ft. 3,577,738 BTU/Cubic Meter

200 Cubic Feet Green sawdust - 5.66 Cubic Meters
1 (unit) hog Fuel 5,500 lbs/Unit - 4500 BTU/lbs.

2495 Kilograms/Unit 9920 BTU/Kilogram
24,750,000 BTU/200 Cubic Ft. 4,372,792 BTU/Cubic Meter

200 Cubic Feet dry shavings - 5.66 Cubic Meters
1 (unit) hog Fuel - 2000 lbs/unit - 8000 BTU/lbs.

907 Kilograms/Unit 17,640 BTU/Kilogram
16,000,000 BTU/200 Cubic Ft. 2,826,885 BTU/Cubic Meter

1 lb. Bone Dry Wood = 9,000 BTU 1 Kilogram = 19,841 BTU

As you are aware a great percentage of the log that you buy ends up in bark, slabs, sawdust, chips, and shavings. We have figures that show that for every 1,000,000 board feet of lumber cut, we should generate 125-200 cu. ft. units of bark and 300-200 cu. ft. units of sawdust plus the average number of units of chips from this volume that go for other products such as pulp.

I have not included chips, dry sawdust, sander dust and planer shavings in any of these calculations. They are another plus that are accumulated in addition to the units that I have mentioned in this report and many use these by-products to make steam.
These by-products you have already paid for and if you can use it for energy instead of gas, oil, or coal you are not out any additional cost for BTU's.

125 Units (200 cubic ft. each) bark = 20,250,000 BTU per unit or a total of 2,531,250,000 BTU
300 Units (200 cubic ft. each) sawdust = 24,750,000 BTU per unit or a total of 7,435,000,000 BTU

The sawdust and bark on this basis for 1,000,000 board feet of 4/4 lumber produces 9,966,250,000 BTU. This is equivalent to 66,440 gallons of fuel oil at 150,000 BTU/gal and let's say at 30 cents a gallon that's worth $19,932.00 or 99,660 therms of gas (a therm of gas is 100,000 BTU) at 12 cents per therm is $11,959.44. This is Seattle gas price which could be lower than other areas. Gas could rise much faster in the future than oil and a very important point is that gas is interruptable in that you could be without it for 3 to 4 months in the winter time when you most need it.

L. V. Teesdale in the Forest Service report R1478 from Madison, Wisconsin back in 1936 estimated 1,500 to 2,050 pounds of steam to dry 1,000 bd. ft. of green Douglas Fir and 3,600 to 5,000 pounds for 1000 bd. ft. of Ponderosa Pine. Some yellow pines will go as high as 7,000 pounds of steam for 1,000 bd. ft. Let's use the figure 5,000 pounds of steam to dry 1,000 bd. ft. of lumber. You can increase or decrease on 10% increments to suit your operation, if you want to figure how much energy you have available in your by-products.

We are using the steam demand figures for dry kilning for one of the greatest lumber demands, 4/4 Ponderosa Pine. As noted above, Teesdale gives us the figures 3,600 to 5,000 pounds per 1,000 bd. ft. with Douglas-fir at 1,500 to 2,050 pounds. Cedar, redwood, hemlock, alder, maple and others in our areas are much below the 5,000 pounds and more in the 2,050 pound class. We are using the 5,000 pound figure so our demands to dry the lumber are high and can take into account efficiencies, losses and others keep this in mind as we go thru the following examples.

From the 1,000,000 board feet of lumber that we have sawn, we have a potential of almost 10,000,000,000 BTU's. Five thousand pounds of steam is approximately 5,000,000 BTU's (required to dry 1,000 bd. ft. of lumber) so 10,000,000,000 x 1,000 = 2,000,000 board ft. of lumber.

Energy and the Dry Kiln

You've sawn a million board feet and we will dry that 1,000,000 bd. ft. With dry kilns with a gross holding capacity of 250,000 bd. ft. of 4/4 lumber on not less than 3/4" stickers and an 84 hour cycle you can dry the one million bd. ft. cut in two weeks.

We have 5,000,000,000 BTU's of energy left and from our tables we see that one boiler horse power is equal to 10.1 kilowatts (KW). (1 KW = 3413 BTU/hr. With the remaining energy you could generate 1,470,000 KW in one hour. You could burn a 100 watt lamp 14,700,000 hours with that energy (1000W-1KW). Now you have a rough basis with figures to start and see how best this energy could help you.

If you used this extra energy over a 14 day period and you cut 100,000 bd. ft. per day on a 5 day basis or 1,000,000 board feet in two
weeks, you would have 80 hours of heavy demand over 2 weeks when the sawmill was running. The remaining 256 hours would be for lights, an air compressor used part of the time for clean up. One million four and seventy thousand KW in one hour when generated equally each hour day and night over 14 days is 4375 KW per hour and with 4375 KW you can light 43,750 - 100 W lamps or you can run 670 - 10 HP electric motors for 14 days 336 hours continuously. It would take approximately a 430 HP boiler to run these 670 - 10 HP electric motors but remember 80 of the 336 hours will require greater energy. The remaining 256 hours will not require KW to run 670 - 10 HP motors or light 43,750 - 100 W lamps. You now can see what a great energy source you have available.

With a 1,000 HP boiler it would be my opinion that you could have enough steam to dry kiln the lumber and enough energy left over to work into lighting, electric motors, heating and almost all of the requirements of a small mill if the energy requirements were carefully studied and adhered to if the project were implemented.

On the basis of oil savings of 66,440 gallons every two weeks that's a year savings of 1,727,440 gallons and at a cost of 30 cents a gallon that's an out of pocket dollar savings of $518,232.00 or $310,945.44 if you used gas, a total of 2,591,160 therms at 12 cents a therm.

As you know many of the larger mills are already using their by-products for energy. We are told that the smaller operator can buy equipment from $75,000 to $100,000 not installed to utilize his dry shavings and sander dust. This can be burned in a regular 600 HP boiler to obtain 300 HP. This material requires a 10 square feet per pound radiation surface which reduces the 600 HP to 300 HP. A unit of this type installed in a northwest sawmill for dry kiln steam saved the mill $65,000.00 in fuel cost last year. Put another way, the mill owner spent $65,000.00 less last year for boiler fuel than year before with the same production. That's $65,000 raw dollars he didn't have to dig up. This installation is a 10,000 pounds (approx. 300 HP) of steam/hour. For 20,000 pounds approximately 600 HP of steam/hour, the equipment could cost in the $150,000.00 to 175,000.00 range and courser pieces up to 2" could be handled as well as wood with a 15% to 40% moisture content. At 40% moisture content and over you would get a light smoke, 40% opacity (100% opacity is a black smoke). I am told inspectors hold a colored card up and compare the smoke from the stack to the opacity card and fine you on the color comparison on this card. This 20,000 pound steam boiler would be an HRT set onto a fire box of firebrick with a spreader stocker arrangement. A demand bin and electrical equipment is included in this equipment (no wiring). The mill would have to prepare the lumber by-product to size. Over 20,000 pounds, 600 HP of steam to 400,000 pounds, 12,000 HP of steam equipment could run $350,000.00 to $400,000.00 and probably $1,000,000 all set up ready to go. These are all very rough estimates and there are engineers in this group from companies who specialize in this work who can no doubt answer your questions better than I. We do however work out programs of this nature but it is on a time and money basis.

With a $518,232.00 savings in using your by-products instead of oil, this is the money available to install equipment to get the maximum use from this free energy. A positive source of steam for your dry kiln.

I am not sure what a complete installation of this nature would be to take advantage of all of this energy but with the amounts available as I
have outlined in this report and with the huge dollars savings by not buying outside energy it would seem to me that every mill should take a good hard look at this potential energy source and cash flow dollar saver.