

# On the possible impact of raising energy costs on the pulp & paper industry

Frankfurt, 02.02.2006

Going to work, I drive 38 km, burning about 3.8 liter in 30 minutes.

It took nature some 300 million years, give and take a few, to convert 100 tons of ancient biomass to make those 3.8 liters happen.

If, as they say and almost all agree, we will run out of oil in 40 years, on February 2<sup>nd</sup> of 2046, we collectively will have burned, in only 150 years or in one-two millionth of the time needed to create it, all the oil that once was, a new world record (this is equivalent to 1 second to 23 days).

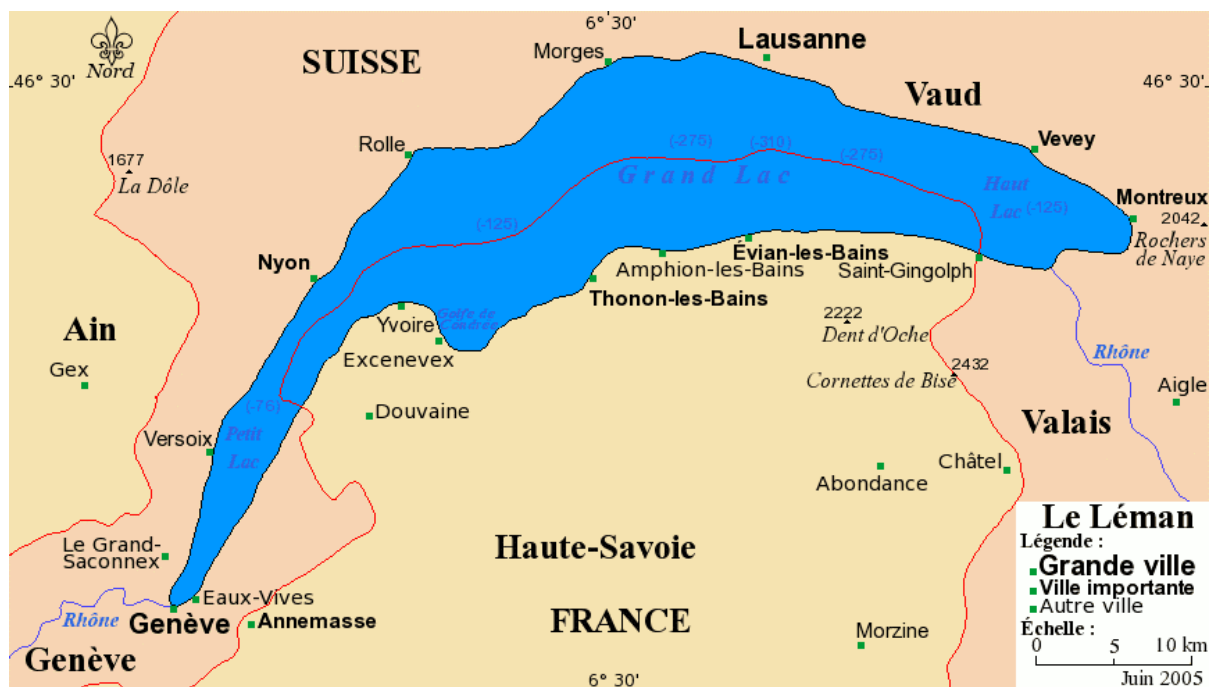
The Lake of Geneva is about 100 km long, 10 km wide and 300 m deep and holds 300 bn cubic meters water.

At 6.3 barrels/m<sup>3</sup>, this give us 1.890 bn barrels.

The world's total endowment of producible 'regular oil' once was 1.850 bn barrels of oil.

The lake is half empty now.

**Welcome to the world of reduced expectations.**



## GOAL

of this presentation is

to create awareness for the impact of increased energy costs on P&W.

Our industry needs/uses enormous amounts of energy inputs, maybe to a higher extent than other process industries (chemicals, steel, aluminum).

In that light, it is important to evaluate the threats and opportunities to our business. We do not have answers, only a few ideas and opinions, which we will put to the test. We may go home today being more confused than when we arrived, but it will be at a higher level of confusion. We will look into:

- is the price rise since 2001 a bubble, or the beginning of a once in a lifetime shift to higher prices? Is PEAK-OIL real?
- the energy used in the production of paper and the possible impact of a sudden shift in costs on prices and demand
- What alternative use is there for our raw materials?

## A. PEAK OIL

Rising oil prices have an impact on the price of all other combustibles, 'goods' with an underlying energy content. Oil is at the top of the energy chain because it is

- Easy to transport
- Highest energy content per unit of volume
- Versatility: transport-heating-fertilizers-plastics-pesticides
- Once upon a time, oil had the lowest thinkable EPR (Energy Profit Ratio -- the energy required to extract the energy contained in a barrel of oil); as oil fields go into decline, their EPRs also decline (below 10 and typically no better than 3). As a field declines, eventually so much energy is used in taking oil out that net yields become insignificant.

In 2006, despite all knowledge, estimating reserves remains a scientific guess. Most estimates, by public companies or states, remain fuzzy; they are only statements.

OOIP (Original Oil In Place)

Probability of estimating reserves correctly is:

- 90% for Proved Producing: wells drilled, oil flows
- 80% **Proved Reserves**
- 50% for probable reserves
- 20% for possible/prospective reserves

**Proved reserves** is the most commonly cited type of reserves (though probable and possible are quite often used in same breath):

- Reserves are only 'Proven' when they can be recovered by current technology and are economically viable;
- Companies must make a financial commitment to bring them into production before classifying them as proven.
- Most companies grew their proved reserves by 15 to 40% more than they produced

Actual production is the most important proof that reserves exist. And the relationship between reserves and production is weakening. Up till a few years ago, as long as prices were falling, the International Energy Agency IEA stated that new discoveries were only a function of the oil price. Now oil prices are much higher, the IEA no longer assumes this causation. If the IEA sees this, then peak oil is past.

No one knows exactly how much oil is left because of bad & fuzzy statistics, based on educated and qualified guesses, but mostly driven by an agenda:

- Generally Accepted Accounting Principles (GAAP) and dwindling reserves with the big multinationals, forced upon them by Securities and Exchange Commission (SEC)
- quota with OPEC producers

Under SEC and GAAP rules, oil companies are allowed to capitalize all costs once “proved status” is achieved; capitalized costs to develop and produce oil & gas can total 90 to 95% of all real costs; these costs are expensed over the life of an oil or gas field. Guess what happened.

OPEC countries were allotted production quota’s based on their reserves; again, guess what happened.

It is a believers v non-believers situation,

- bears who say we are seeing the bottom of the barrel, versus
- overly optimistic bulls who believe ingenuity and creativity will find ways to use less energy and new ways to produce- conserve energy; plus higher prices will reduce consumption and increase supply (increased marginal returns pay for exploitation of marginal fields)

Technology:

- geophysical work, 3-D visualization modeling etc. lead to widespread belief oil prices will steadily fall
- Oilfield technology accelerated the speed of draining the reservoir; occasionally it increased the ultimate recovery of a field

**M. King Hubbert**, an American Shell Oil Co. geophysicist produced a methodology to assess how output oil varies with time.

*In 1956, he correctly predicted the rise in production, the peak between 1966 and 1971 and the subsequent fall in output of oil fields in the USA. It peaked at 9.64 million b/day in 1970 (had dropped to 5.74 million barrels in 2004, according to the EIA).*

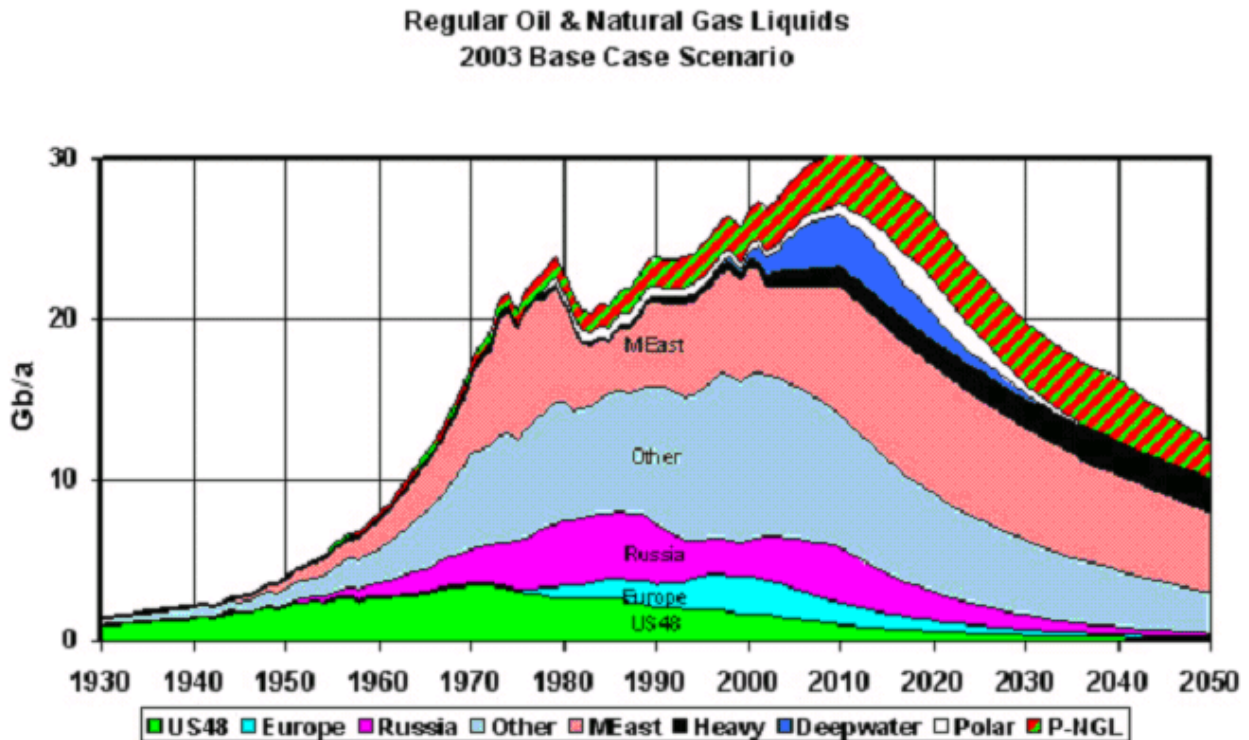
*What works for one oil reservoir in fact works for the entire conventional oil industry. By applying this same process to global oil resources, other researchers have produced varying estimates for the peak in global oil production; they all range between 2005 and 2015.*

*Peak-oil is the 50% point: 50% depleted – 50% left*

*On the upslope, oil is plentiful & cheap as demand is below supply, and supply is high because the authorities that ‘own’ the wells need income for their population.*

*On the down slope, oil gets scarce & expensive as demand outstrips supply (at a given price); energy is capital intensive and swings between sources is limited in the short run.*

Over the peak, costs go up & production declines (a fact inherent to bell curves)  
 What matters is when oil ceases to run – peaking events are only visible through the rear view mirror, and hard to predict



Oil consumption growth  
 2004 - 2.5 mbb/d  
 2005 - 1.2  
 2006 - 1.6 to 1.8 reaching 85 million bb/d

A few titbits:

*Institute of Petroleum (London; Shell, Esso, BP, Texaco) publishes School Science and gives as reserves at today's rate of consumption: 40 years for oil, 65 for natural gas and 225 for coal.*

*In 2004, 5 majors (Shell, Exxon Mobile, Chevron Texaco, BP, Total) produced 3.2 bn barrels (or 10% of total market) and had 40 bn barrels reserves left or 12.5 years on average. By June 2016, they will have to buy all their oil from third parties (state run oil companies). Their oil production diminishes year after year.*

*Oil multinationals may well have known, for years now, that*

- world oil production will start declining somewhere between 2005-2010
- the wells they fully control will run dry by 2016.

*So why invest \$3-4 bn in extra refining capacity when today's refining capacity can handle the 85 million b/day*

*In 2005, Russia's integrated oil companies earned higher profits per barrel on refined product exports than on crude oil. The state takes 80 cents on every extra dollar when the Ural benchmark price is above \$25 a barrel. Oil is a fungible. And power too. Mr. Putin knows.*

*Reduction of Proven Reserves:*

*Shell by 20%, Repsol just now (Week of January 23, 2006) with 25%*

*Matt Simmons, founder and CEO of Simmons & Company, a world leading investment banker (and an authority in energy matters) is convinced that besides oil, gas also is already on the south side of the slope.*

*Canadian tar sands are an important alternative (as is shale oil). Both have low EPRs but regardless, the EPR is positive. It's not clear whether the low EPR is the result of a thermodynamic limit or current technology. There are also issues of its environmental impact.*

Possible conclusions:

- Oil prices were too low for too long
- Oil prices were cyclical; what goes up must come down and return (as some say) to the \$20 to \$30 bandwidth; watch those futures out to 2009 (but futures are not reliable predictors of actual prices)
- Cost to convert raw energy unto useable energy is extremely high

## **B. PAPER & ENERGY**

There are rather complicated calculations to get to the energy that is embodied-consumed-wasted to produce one tonne of paper.

INPUTS:

- trees are cut with feller-bunchers, transported by truck to the sawmill
- sawmill residues (1 ton of chips have .3215 toe – tonne of oil equivalent – 3 tons chips equal one tonne of oil) are transported to pulp mill, mostly by truck
- a modern pulp mill is energy self-sufficient; we use 2.2 tons wood or 0.7 toe to end up with one ton of pulp that contains roughly 0.33 toe (using up 54% of the initial energy).
- pulp then is shipped all over the globe by ship, train or truck
- a paper mill consumes huge amounts of energy in its process (refining, paper machine, coater) and all raw materials have high energy contents (wood for SGW/TMP, waste paper or pulp)

Take a modern paper machine producing UC WF

- using 66% HW, 9% SW and 19% filler, the remaining 6% are water
- all pulps used are produced in a modern mill, using no fossil fuel
- SW chips traveled 300 km in 50 tons trucks to the pulp mill, 200 km for HW chips (45% yield/50% moisture)
- SW pulp moved 17000 km by ocean vessel to the paper mill, and 5000 km for HW

Based on the above model, my colleague Mike Bradley calculated (using LCA inputs) the following chemical energy numbers (this estimate doesn't include the energy to actually make the paper):

- 11 GJ total process energy, i.e. the energy used up to produce the products and get them to the mill gate; 2.8 GJ of these 11GJ was energy in the wood chips for a fossil free value use of 8.2 GJ;
- 38 GJ total extracted energy, i.e. energy that was depleted (or 35.2 GJ fossil free)

Conclusion: 27 GJ or 76% of the original energy content that were available on earth, were irreplaceably lost in the process because processes are not efficient, energy lost in conversion.

The net calorific value of 1 tonne of oil equals 42GJ. Energy wise, we extracted (and depleted) the equivalent of 905 kg oil, wasting 643 of them to bring the equivalent of 262 kg to the mill gate. \$60/barrel crude oil are sold at \$460 per ton. The energy content of the raw material alone 'costs' \$420!

In 2004, Juhani Lehtonen from GloCell Oy calculated the following average manufacturing costs in Europe for a 60 gsm LWC, the cheapest process being the spruce TMP based:

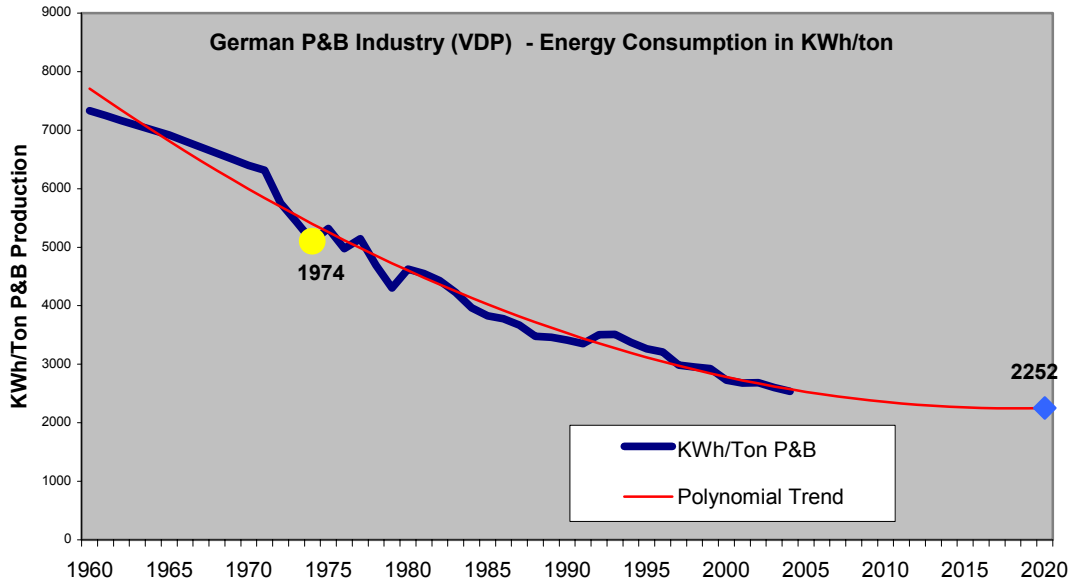
- salary and labor: \$42/ton
- chemicals, fiber and materials: \$285
- electrical power and fuel: \$250

Overly simplified, adding apples with pears, one can state that a tonne of paper at the mill gate, used up \$420 + \$250 or \$670 in oil equivalent. What is the price UCWF or 60 gsm LWC sells for, FOT mill gate? If oil prices lift all boats, energy prices may well be on the rise.

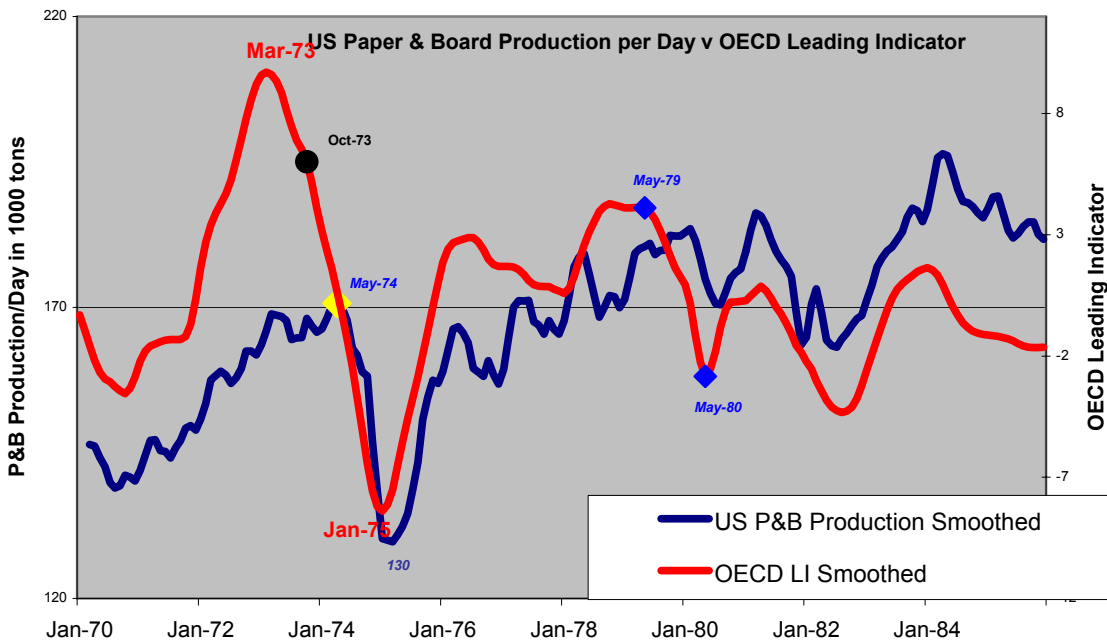
This is the situation today. How then was it 30-35 years ago, during the first oil shock? The graph below is based on the energy consumption in the German paper industry (VDP Annual Reports – in kWh/ton), a major paper and board producing country with a relative low average machine age per ton of paper & board.

The graph shows a few remarkable facts:

- from 1960-73, when energy was dirt cheap, engineers did their utmost to reduce the energy consumption;
- the polynomial trend based on 45 years data (some earlier ones interpolated though by yours truly) shows that the reduction continues but at a slower pace;
- under a ceteris paribus conditions, our industry will remain energy dependant, falling from 2573 kWh/ton in 2004 to an estimated 2250 kWh in 2020.



The second graph shows the US P&B production versus the OECD Leading Indicator. A learning from this presentation is that I was unaware of the fact that the US economy was already in sharp decline as from March 1973 on (after a stellar expansion), 6 months before the oil crisis started. Or: against my recollection, it was not only the oil crisis that sent P&B off the tracks.



As from around May 1974, P&B production dropped a never seen before 24% to recover to above its 1974 level only by April 1978, to be hit shortly thereafter by the second oil crisis. Yes indeed, these were the good old days.

*We still have to do some more digging*

*- once the data promised by VDP arrive.*

*- Energy as % world GDP*

*- Increased energy means a combination of extra tax + inflation with slower growth and even less paper consumption. Paper prices rise in relation to GDP, means even lower demand, hence even more overcapacity. A double whammy for P&P*

### **C. Alternative uses for our raw materials**

The European pulp and paper industry is the biggest industrial producer and consumer of renewable energies.

But utilities can afford to pay higher prices for wood.

The European paper industry is getting increasingly concerned about the ease with which energy companies (utilities) drive up prices of wood and its residues.

**ENGO's** have a much more friendly attitude towards the use of wood for energy than for use in other applications, read pulp and paper.

Just last week, 50 NGO's from all over the globe agreed to combine their efforts to reduce paper consumption in Europe by 50% by 2015.

Post Kyoto, wood-derived energy is preferred over fossil energy.

Research centers worldwide are concentrating on ways to convert wood into a substitute for resins from oil (the bio-refinery concept). Measured by the returns from the past decade, it must not be that difficult to make more money from these substitutes than from paper, forget about pulp.

It is unrealistic to imagine that wood-waste or any other form of biomass can take over from fossil in the near future. Logistics of collection and transport will allow them to compete only in special 'applications'.

Conversion of sunshine into biomass compared to its conversion into oil or gas is not only quicker by millions of years but is also more efficient by about 5000 times. Burning wood is more efficient still.

#### **1. Wood pellets**

Are shipped today to Europe from L-America (eucalyptus) and Canada (softwood from BC); pellets buy Kyoto credits, because the convention treats wood as a carbon neutral material. Pellets are mainly sold to utility companies.

Cy C.H. Anderson announced early 2006 its intention to build 4 new pellet plants in B.C.. The four mills will employ 640 people and pellets could be shipped to Europe and Scandinavia as soon as next fall. Total investment for the 4 greenfield mills is C\$110 million or C\$ 27.5 million each.

Each plant will consume 400.000 OdmT of woodchips and other residues. 1.6 million tons of chips are equivalent to what one state of the art NBSK mill of 750.000 tpy would need, an investment priced around US\$ 1.2 bn, say C\$ 1.4 bn rough and dirty.

Pulp and paper are capital intensive and a volatile business. Equity investors should receive a premium to the industry's weighted cost of capital (which ranges 9% to 12% in P&FP industry) or a 300 to 450 basis point risk premium over current bond yields (around 4.3% today) says Salman Partners (Blue Review- Jan 2006).

Forestry companies need steady and secure buyers for its saw milling residues. It makes or breaks their profitability. As the volumes are high, pulp mills were prime outlets, once. If we take 9.25% - the average of the two forks mentioned by Salman - as a reasonable cost of capital for a solid company like say Canfor, and imagine that a pulp mill can be up and running after one year of construction, then the 1.4 bn dollar at 9.25% would have siphoned away already C\$130 million before the first ton of pulp was produced. This is more than the total investment in 4 pellet plants. Now again, imagine, you are the CEO who has to convince his board for a C\$1.4 bn investment in pulp. You got it.

**Energy content of 'combustibles'**

	Kcal/kg	Pellets = 100
Heating oil	10300	2.4
Coal	6200-7400	1.6
Pulp/Paper	4600	1.1
Wood pellets	4300	1.0
Air dry wood	4000	0.9
Dry split wood	3000	0.7

**Wood Costs - US\$/OdmT**

2005 - Average Q1-Q3

	SW	HW (rwd)
Average ww	93	74
Canada East	135	68
BC Interior	65	---
Finland (rwd)	133	95
Sweden	113	93
Germany	96	---
Chile (rwd)	67	61
Brazil	---	68

Source: Wood Resources Quarterly

Canadian wood pellets have a calorific value of just over 5.0MWH per ton or 18.5GJ per ton. For a few years now, pellets to major power producers in Europe sell at prices stable around €27.5 per MWH or €7.45 per GJ

1 tonne of pellets sells @ €27 \* 5 = € 137.5/ton = \$165 per ton, leaving a conversion margin of US\$100 per tonne.

### Point of Indifference of Oil v Wood

OIL - unrefined			Refined	Indifference point in \$/Ton	
\$/Barrel	\$/1000 liter	\$/ton	\$ Cost	Pellets	Wood \$/ton
Conv. factor	0.159	0.82	+U\$220/ton	-/2.4*	/3.4**
20	126	153	\$373	\$156	\$110
50	314	383	\$603	\$251	\$177
60	377	460	\$680	\$283	\$200
70	440	537	\$757	\$315	\$223
80	503	614	\$834	\$347	\$245
90	566	690	\$910	\$379	\$268
100	629	767	\$987	\$411	\$290

\* 2.4 units pellets have same caloric values as 1 ton oil

\*\* 3.4 ton of split dry wood = 1 ton oil

The caloric value of pellets is approximately 42% of that from oil (and heating oil)  
Crude and unrefined oil at 60\$/barrel means U\$ 460 per ton or €380,  
refined it is \$680 and €560.

Pellets at €7.15 per GJ times 42 equal € 300 per ton oil.

OR: because of their huge bargaining power, utilities still only pay 55% of the price of refined oil, not to mention the Kyoto credits they pocket. Even if they paid the same as for crude, this would mean another 100\$ per ton of pellets, doubling its conversion margin.

We could apply the same logic to waste paper, and why not pulp. Per tonne, pulp has about the same caloric value as pellets. Hence, when oil is at \$60, any ton of pulp that doesn't make a mill net of \$283 can better be burned at the mill instead of destroying more non-renewable energy in transport. Should oil prices reach \$100, the, \$411 is already the breakeven point. Then the question rises: why go through the expensive process of producing pulp?

2. Wood can be converted into liquid fuels by **hydrogenation** (gasification of wood with steam and oxygen can produce a synthetic gas that can be converted into almost any hydrocarbon).

**Pyrolysis** of wood can generate basic chemicals such as alcohols, acetone, charcoal briquettes.

Other possibilities are gasification of back liquor at pulp mills, or gasifying chips directly.

### 3. Urban waste plants

Environmental activism is a thing from the 68-ers.

Youth no longer have that high interest in environmental matters.

The attitude towards NIMBY also changes. As soon as energy prices will bite into the consumer's budget, state of the art incinerators (no dioxins, no furans), with heat and electricity recuperation from burning waste within the confines of a city, will be built provided the cost advantage flows straight back into their pockets.

**Conclusion:**

Paper remains a major user of energy, in all its forms. Also most of the raw materials used are themselves products with a high energy content. A shift in the relative cost of all these inputs not only increases cost for papermakers, forcing them to lift sales price, where price elasticity kicks in.

All fiber based raw materials themselves may be used as raw materials for other usages, read as energy source. Increased competition, as new players enter the market, further drives prices.

Pulp hasn't been profitable for some time. Prices have to be very attractive for some time before it will again be a darling of the investment community and attract new investments.