"Bundles of Energy from the Forest – a Finnish Success Story"

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John Deere Forestry as a Company

**A World Leading Forest Machine Company**
- Global Market share > 40%
- Belongs to John Deere Corporation
- Net sales > $5.877 milj. (JD Corp.)
- Employees: 2000 (John Deere Forestry)
- Production, Finland (CTL), Canada & USA (FT)
- Own company in 13 countries
Forwarders

Bioenergy Technology
UNITS

- toe = oil ton equivalent. The energy content of oil. Refers to 5-6 s-m3
- MWh = Megawatthour. One solid m3 of wood contains ~ 2MWh of energy
- 1-m3 = Loose cubic meter. Refers to 0.4 - 0.45 cubic meters of solid wood (s-m3)
- s-m3 = Solid cubic meter. Corresponds to 2.2 - 2.5 cubic meters of chip

Shell Forecast for Energy Consumption
Residues to Revenues Australia 2007

Shell: Consumption of Different Energy Sources

Shell World Population Energy and Demand
International Agreements

- **KYOTO Agreement 1997**: 
  - Countries should reduce CO2 emissions 
  - 8% by 2010 compared to the level of 1990

- **EU White Paper 1998**: 
  - Double the share of renewable energy sources 
  - from 6% to 12% by 2010

- **USA Ministry of Energy June 2000**: 
  - Increase the share of renewable energy sources from 3% to 10% by 2010

THE BIGGEST PROBLEM WITH ENERGY?

**How To Store Energy For THE PEAK CONSUMPTION!**
Why Energy from Forest Biomass Then?

- Way to store the solar energy
- 100% renewable energy
- Neutral CO₂ balance
- Local energy source
- Employment potential in rural areas
- “Crisis free” energy
- Cleaner landscape and faster reforestation after cleaning the site

Recycling Carbon

[Diagram showing the recycling of forest biomass]
National Objectives

• **Finnish National Bio Energy Program 1999-2003:**
  – Objective to increase the utilization of chips
  – 0.5Mm3/a >> 2.5Mm3/a

• **Finnish Ministry of Trade and Industry Program for the renewable energy 2000:**
  • **Year 2010 >>**
    – 50% increase from 1995 (3 Mtoe)
    – 27% of the total energy consumption
  • **Year 2025 >>**
    – 100% increase from 1995 (6 Mtoe)
    – 35% of the total energy consumption

Finnish Ministry of Trade and Industry

• The employment of renewable energy and energy saving in from 1999 = 8,000 people

• The increase of employment when the fossil fuels are replaced by the renewable energy:

• By 2010 direct new employments
  – 10,000 new employments in Finland approx. 25,000 direct + indirect and export
Forest Biomass in Finland

- Annual cuttings of forests 60 Mm³
- Annual growth of forests > 70 Mm³
- Annual non used forest biomass 10 - 15 Mm³ (logging residuals and cleaning of young forests)

Wood Energy in Finland

- Share of wood based fuels 72 TWh ~ 20 % of total energy consumption
- Existing potential of unused forests biomass 10-15 Mm³ ~ 20-30 TWh (including young forests and logging residuals, Tapio 2000)
RES Development in Finland

- Finland has increased the use of the RES the most in the EU
- This is due to the right policy of the government
- There is nowadays very positive atmosphere to develop renewable energy and sustainable methods

Finland: Annual Residuals in the Forest 20 million tons

- Out of that utilized below 1 million tons

Source: Residuals of Production and Consumption/Center of Statistics 10.01.2001
Basic Problem of Biomass Utilization: Transport Economics

History of John Deere Energy Technology

- 1997-1998 Feasibility study on Bioenergy Business for Timberjack
- KMW Energi Ab, 25% shares, 1999 (ERJO, Markaryd and KMW Energi, Norrtälje, Sweden)
History first guess / try

History of John Deere Energy Technology

- Co-Operation agreement with Fiberpac Kb, Vislanda, Sweden 1999
- Fiberpac 370 product rights 2002
New Technology

Saw Logs and Bundles at the Same Inventory
Slash Bundles

As a Result a New Product for Renewable Energy was created
– John Deere 1490D
Pilot Project in Finland

Alholmens Kraft / Pietarsaari

Alholmens Kraft, winter 2001, P= 550MWth
Annual Production and Consumptions of Pietarsaari Power Plant

Fuel ca 3 500 GWh

- Peat 45%
- Bark and Wood waste 45%
- Heavy fuel oil and coal 10%

Max. fuel consumption 800 - 1000 m³/h

Oy Alholmens Kraft Ab

- 700 GWh heat
- 1 300 GWh electricity

Total capacities of Oy Alholmens Kraft Ab:
- Electricity
  - New power plant 240 MW
  - Existing power plant 25 MW
- Heat
  - Process steam 100 MW
  - District heat 60 MW

Complete Chain

Complete Chain to Revenues Australia 2007

Residues to Revenues Australia 2007
While working, harvester accumulates the slash on piles that are faster to feed into bundling machine. Accumulating slash slows down the operations in some extend and thus contractors will get a small contribution for doing this. Today it is 0.2-0.3€ / produced wood m3.
Bundling

- Bundling machine will produce “slash logs” that are > 3 meters long and about 0.7-0.8 meters in diameter. Bundles are wrapped with strings in every 20-60 cm.
- Machine can produce about 20-30 bundles in hour each weight avg. 0.4-0.7 tons.
- 50,000 bundles / annually (one shift)

Bundling

- Bundles can be forwarded with a standard forwarders. Each bundle contains about 1 MW of energy when combusted (equals 80-100 litres of oil). The bundles are handled like other assortments and those will create similar stacks on roadside landings.
- Compact bundles do not start to compost as easily as loose slash pile. As well it is not as sensitive to moisture (covering not required).
Bundles at the Plant

- The bundles will be transported to the heating plant with standard on-road trucks. Crushing or chipping is done at the power plant to transfer the bundles into the right size of particles for combustion.
- The “green” chips are often mixed with other energy material like bark, sawdust, and peat.

John Deere 1490D in the forest
Forwarding the Bundles

Three Product Sorts (Pulp, Saw Logs and Bundles)
Bundles Transporting

World's First Slash Bundle Train
Fuel Handling

including 60km road transport, i.e.

10€/MWh ~ 20€/ton

Residues to Revenues Australia 2007
Use of Bundles at Alholmens Kraft

- 590 bundles/ hour
- i.e. 9 full truck loads/ hour
- 14,160 bundles/24 hours
- 216 Full truckloads/24 hours
- i.e. 270 metric tons/h
- i.e. 6,500 metric tons/24 h

Tested in Autumn 2003

Slash Bundle Benefits

- Easy to Store, clean road side storage
- Dryes to < 40% moisture content
- Clean, problem free and easy to control
- Large volume flexibility – without extra costs
- Control through the "normal" wood control system Logistically easy “assortment”, Off-road and On-road transportation with standard equipment
- High density; important factor as yarding or on-road transportation distance increases
- High utilization rate of the equipment and machinery
- Electric driven grinding can be utilized
- Everybody likes the system ➔ bundling has lifted the biomass utilization to a new higher and industrial level
Logging Residuals and the Environment

- better scarifying quality and lower cost
- easier plantation when the smaller and cheaper plants are used
- regeneration of the forest is at least one year faster
- plants will survive better
- there is more natural plants growing
- hay prevention is minimised

Energy consumption of the total chain is less than 3% of the produced energy

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Price

![Graph showing relative price of fuel with different procurement methods]
Conclusions

- The Bioenergy Utilization and Technology is on a rapid increase in Finland
- John Deere has been able to introduce the new technologies presented in this paper into the other countries too
- Bundling lifts the forest residual utilization on a new “industrial” level
- Bundling is very potential method for fire prevention

THANK YOU!

We’ll do it GREEN!

see also:

www.johndeere.com