IEA Bioenergy

Wood based Bio Hubs

Dan Bergström, Associate Professor
Swedish University of Agricultural Sciences (SLU), Department of Forest Biomaterials and Technology
dan.bergstrom@slu.se

Bio-hubs as keys to successful biomass supply integration for bioenergy within the bioeconomy

Joint IEA Bioenergy Task 43 & BioEast Initiative Workshop

Sopron (HU), 10 October 2019

IEA Bioenergy

Bio-hubs as keys to successful biomass supply integration for bioenergy within the bioeconomy

Joint IEA Bioenergy Task 43 & BioEast Initiative Workshop

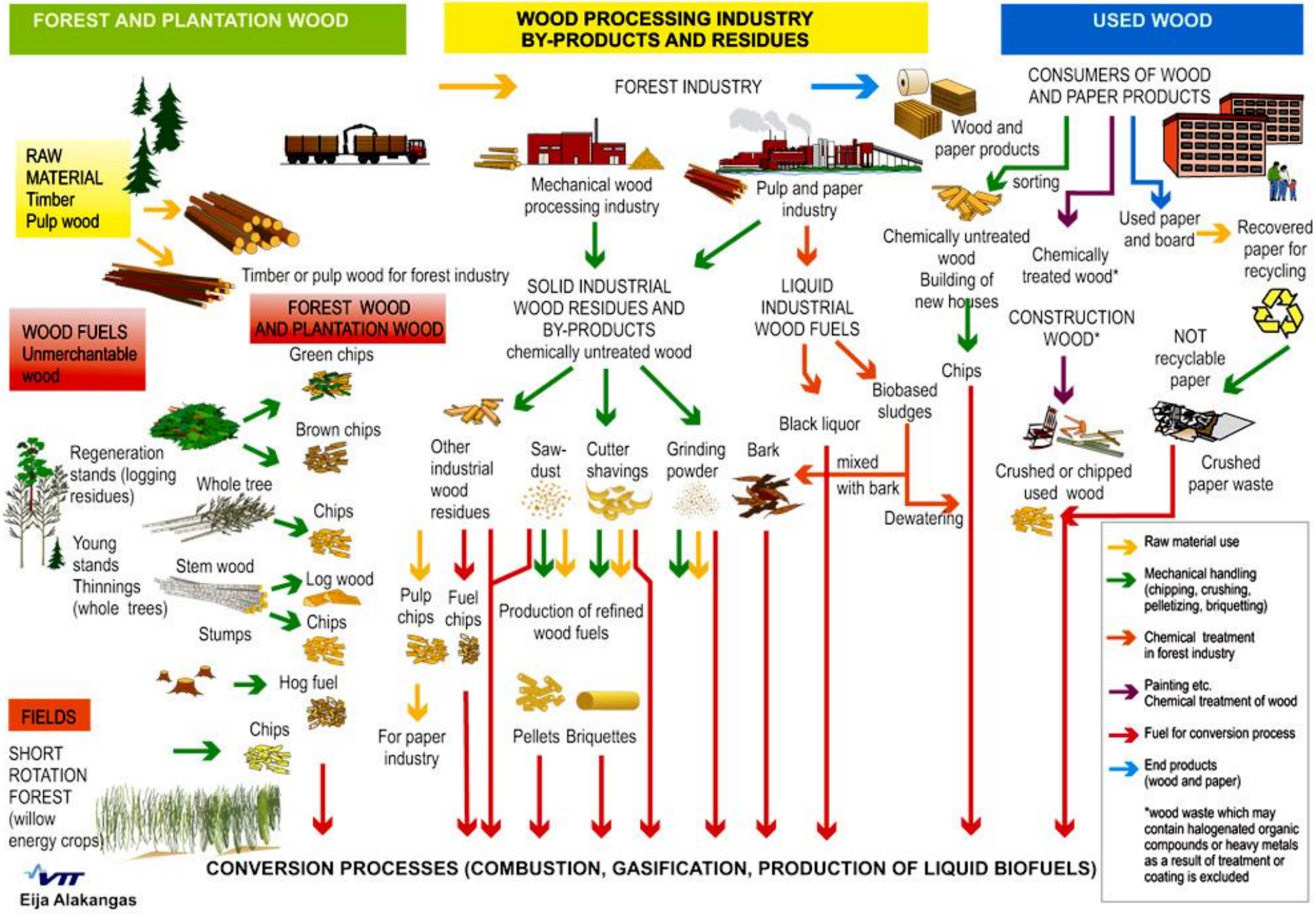
Sopron (HU), 10 October 2019

Some stats for Sweden

- Productive forest area
  - 23.6 Mha
    - 82% conifers (pine 39%)
  - 58% of land areal
  - Ca 1 Mha constitutes of National parks etc
- Stock, productive forests
  - Total: 3180 Mm3sk
  - Growing: 119 Mm3sk
  - Harvest 2019 (prognosis): 94 Mm3sk (new record!)

… Wood supply

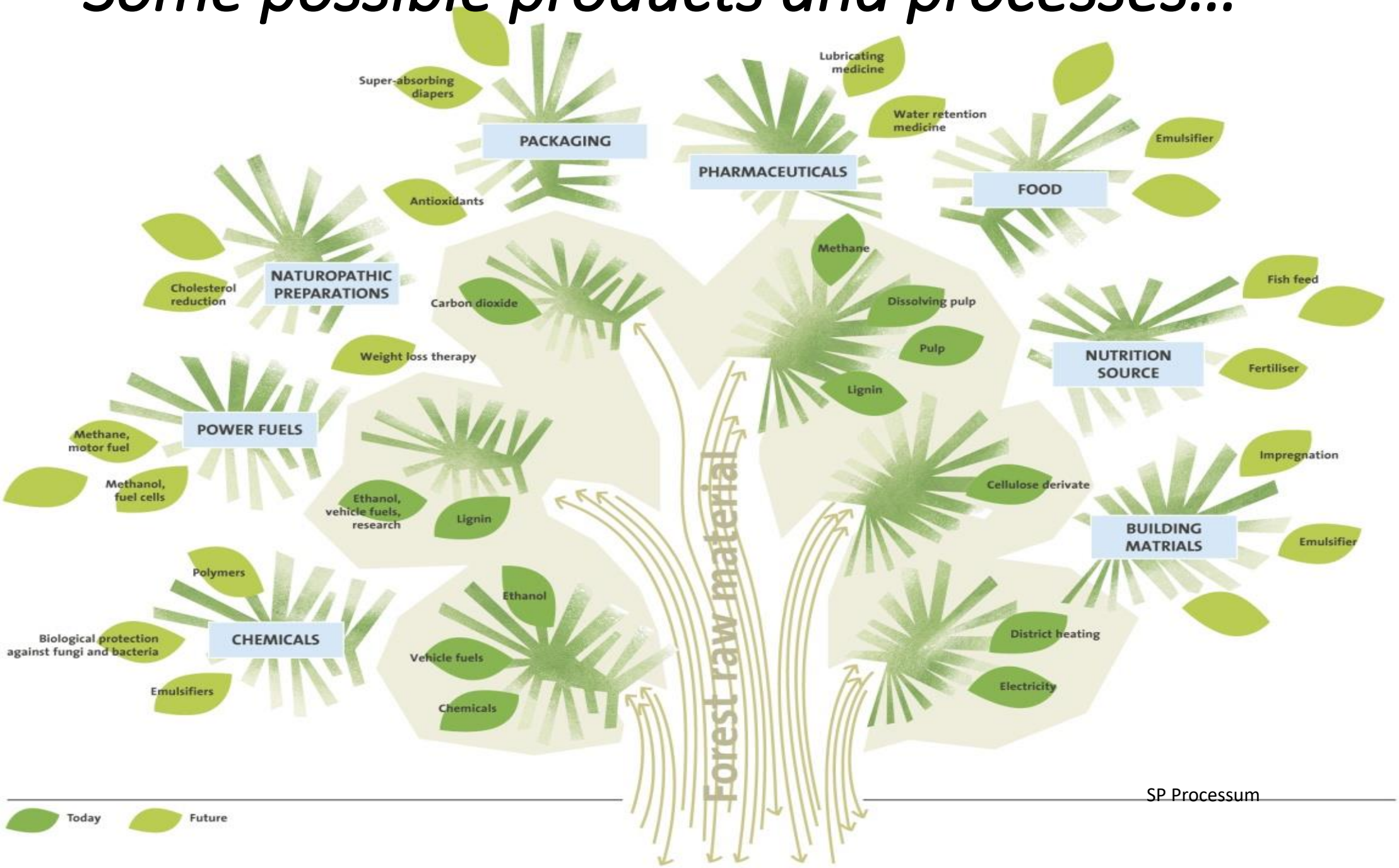
- Individual industries are supplied by many forest owners
- Industries share self-supply by own logistics is 25–50%.
- Wood flow from forest to industry is a complex network of business transactions
- 150 000 unique harvesting sites per year
- 5–15 assortments per harvesting sites that shall be transport to many different destinations.
- Customers demand of security of supply differ
- Etc.


FOREST AND PLANTATION WOOD
WOOD PROCESSING INDUSTRY BY-PRODUCTS AND RESIDUES
USED WOOD
FOREST INDUSTRY
CONSUMERS OF WOOD AND PAPER PRODUCTS
RAW MATERIAL Timber Pulp wood
Wood and paper products
sorting
Mechanical wood processing industry
Pulp and paper industry
Timber or pulp wood for forest industry
Chemically untreated wood
Building of new houses
Chemically treated wood*
Used paper and board
Recovered paper for recycling
SOLID INDUSTRIAL WOOD RESIDUES AND BY-PRODUCTS chemically untreated wood
LIQUID INDUSTRIAL WOOD FUELS
WOOD FUELS Unmerchantable wood
FOREST WOOD AND PLANTATION WOOD
Green chips
Brown chips
Chips
CONSTRUCTION WOOD*
NOT recyclable paper
Chips
Biobased sludges
Black liquor
Regeneration stands (logging residues)
Whole tree
Young stands Thinnings (whole trees)
Stem wood
Log wood
Chips
Stumps
Other industrial wood residues
Saw-dust
Cutter shavings
Grinding powder
Bark
mixed with bark
Dewatering
Crushed or chipped used wood
Crushed paper waste
Pulp chips
Fuel chips
Production of refined wood fuels
Hog fuel
Chips
FIELDS
SHORT ROTATION FOREST (willow energy crops)
For paper industry
Pellets
Briquettes
Raw material use
Mechanical handling (chipping, crushing, pelletizing, briquetting)
Chemical treatment in forest industry
Painting etc. Chemical treatment of wood
Fuel for conversion process
End products (wood and paper)
*wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment or coating is excluded
CONVERSION PROCESSES (COMBUSTION, GASIFICATION, PRODUCTION OF LIQUID BIOFUELS)
VTT
Eija Alakangas

Bioeconomy = new Business opportunities!

- **High biomass utilization and many biomaterial qualities >>**
- **Biomaterials need to be identified and sorted out and treated well >>**
- **Integration of biomaterial flows, e.g. waste, forest and agric.!**

Some possible products and processes…



Biorefineries – some uncertanties!

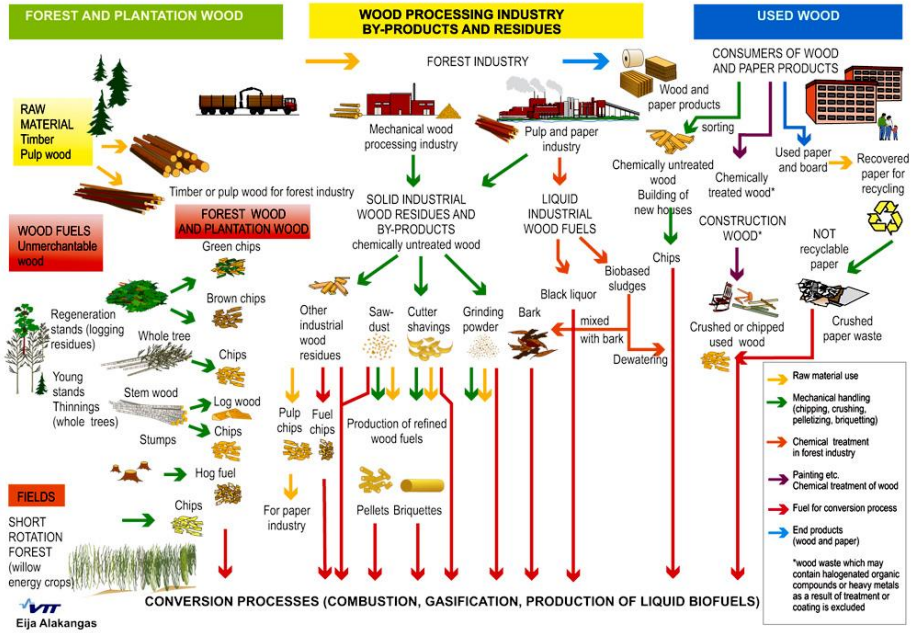
- **End-products – what products will be produced?**
- **Process choice – which industrial processes will be run?**
- **Raw-material quality – what requirements have these industries?**
- **Seasonal demand – even production over the year?**
- **Centralized or decentralized units – size of plants?**
- **Stationary of mobile units – mobile processes??**
- **Specialized of flexible processes?**
- **Integrated plants or stand-alone?**
- **Etc…**

IEA Bioenergy

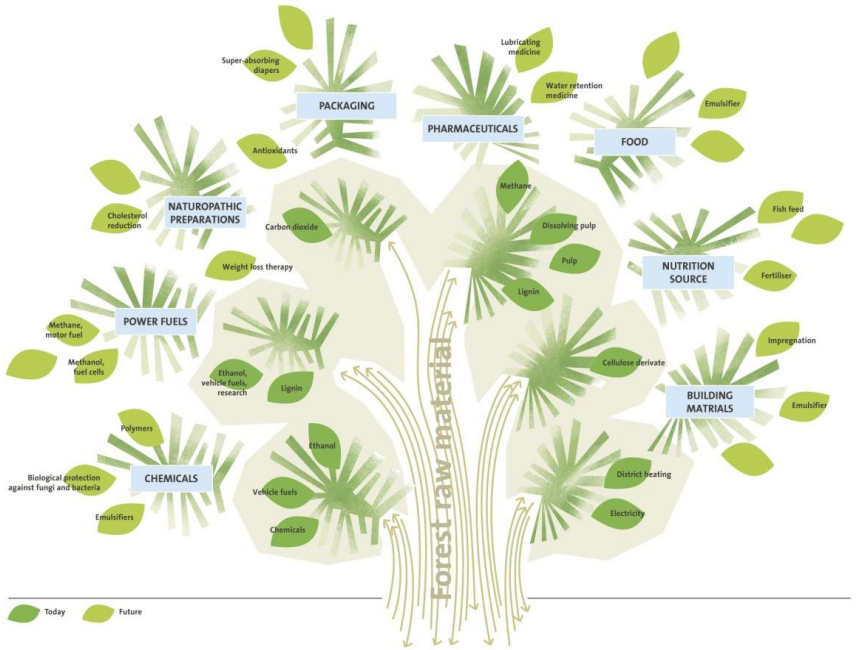
How to secure supplies in a bioeconomy?

IEA Bioenergy

Complexity…



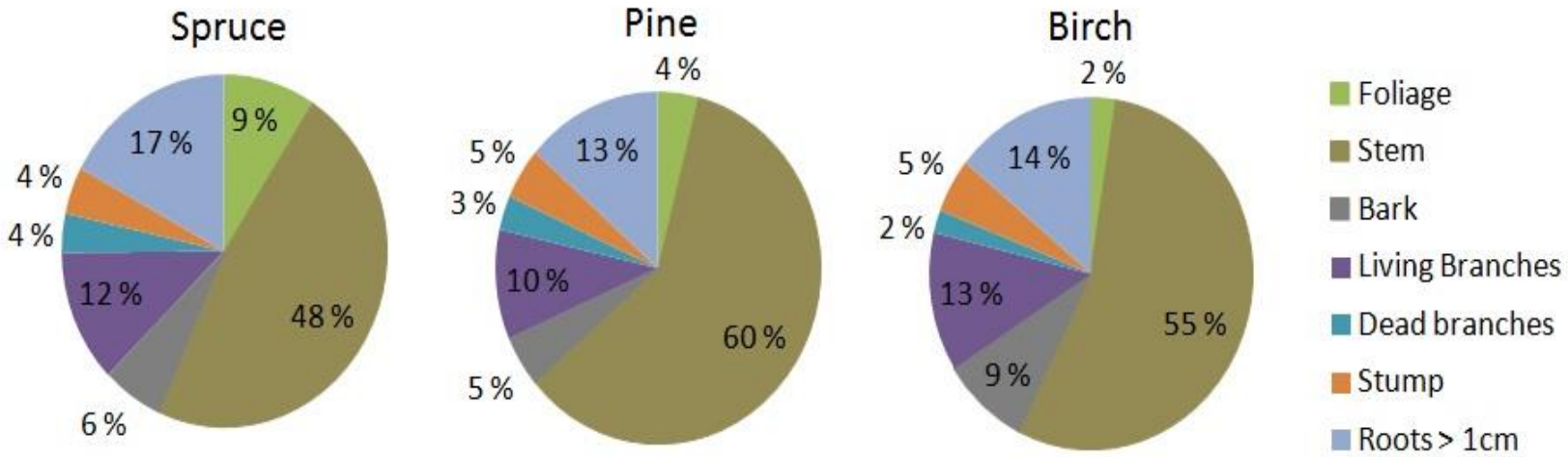
+



+ New and additional market players/supply demands = …

Vast number of qualities to handle in the supply chain.

- Produce qualities (and quantities)
- Measure properties
- Sort out qualities
- Secure quality
- Modify materials (pre-treatment)



(Repola 2008,2009)

Tree species	Cellulose	Hemicelluloses	Lignin	Extractives
Scots pine				
Stem wood (1-7, 11, 12, 27)	40.7 (0.7)	26.9 (0.6)	27.0 (0.0)	5.0 (1.0)
Bark (7-12, 27)	22.2 (3.2)	8.1 (0.4)	13.1 (5.4)	25.2 (5.2)
Branches (11-14, 27)	32.0	32.0	21.5 (5.9)	16.6 (7.1)
Needles (3, 11, 12, 27)	29.1	24.9	6.9 (0.8)	39.6 (1.3)
Stump (12)	36.4	28.2	19.5	18.7
Roots (12)	28.6	18.9	29.8	13.3
Norway spruce				
Stem wood (3-6, 15-18, 27)	42.0 (1.2)	27.3 (1.6)	27.4 (0.7)	2.0 (0.6)
Bark (9-12, 17, 19, 20, 27)	26.6 (1.3)	9.2 (1.1)	11.8 (0.9)	32.1 (3.8)
Branches (11, 12, 14, 17, 27)	29.0	30.0	22.8 (1.7)	16.4 (2.6)
Needles (3, 11, 12, 27)	28.2	25.4	8.4 (2.1)	43.3 (2.3)
Stump (12, 21)	42.9	27.9	29.4 (1.8)	3.8 (0.2)
Roots (12)	29.5	19.2	25.5	15.7
Silver/Downy birch				
Stem wood (1, 5, 11, 12 15, 18, 22, 27)	43.9 (2.7)	28.9 (3.7)	20.2 (0.8)	3.8 (1.3)
Bark (11, 12, 23-25, 27)	10.7 (0.3)	11.2 (0.5)	14.7 (3.9)	25.6 (1.1)
Branches (11, 12, 26, 27)	33.3	23.4	20.8 (3.9)	13.5 (3.0)
Leaves (11, 12, 27)	N/A	N/A	11.1 (0.0)	33.0 (0.0)
Stump (12)	29.5	19.4	13.4	4.7
Roots (12)	26.0	17.1	27.1	13.5

SMART management systems

- Silviculture – designing the source!
  - Species, thinning regimes…
- Harvest – select and define quality of tree parts!
  - Measure more qualities and quantities' in field
- Overall supply management
  - right quality to right industry…
  - value optimization!
  - **>> BioHubs – sort out, mix, pre-treat and manage supply of biomaterials!**

BioHub services

- **Reloading point**
- **Storage point**
- **Measuring point**
- **Chipping point**

Current "biohub" services

- **Sorting point**
- **Mixing point (forest, agri, waste…)**
- **Pre-refining point**
  - **Drying, torrefaction, extraction, pyrolysis…**
- **Etc…**

One example of a possible business concept (a simple one!) of biomaterial flow through a Biohub :

- Market situation
  - Demand for extractives-, cellulose- and energy-rich biofuel fractions
- Possible unutilized resource
  - Small diameter whole trees from boreal thinnings

Business concept:

Cut trees…

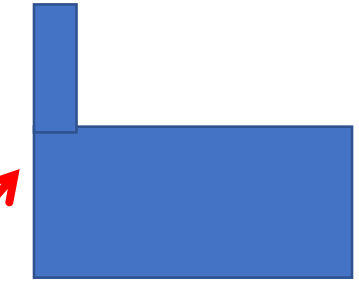
Separate fractions at terminal

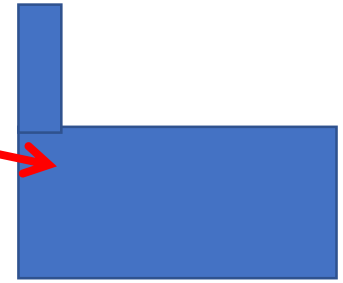
Stemwood

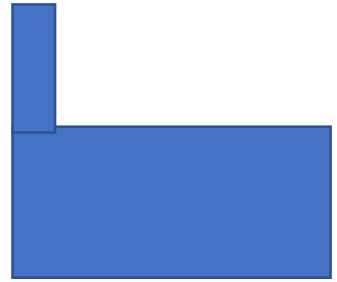
Stem Bark

Foliage

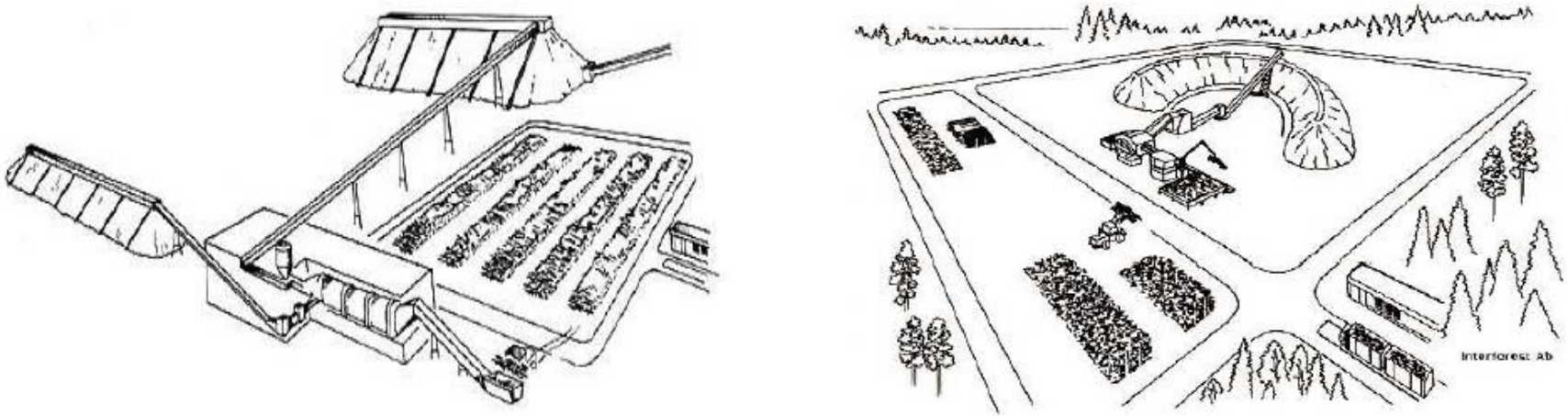
Sell the stuff to biorefinieries!







We did this back in the late 70ties – mid 80ties (cf. oil crisis)…



(a) (b)

Figure 1.3: (a) Stand-alone tree section terminal for processing unlimbed pulpwood and fuel wood (b) Stand-alone biomass terminal for producing fresh fuel chips (Lönner, 1985).

(a)

(b)

Figure 1.4: (a) A delimbing drum at a forest biomass terminal (Photo: Jonas Palm) (b) Chain flail delimbing during terminal operations (Photo: Kalvis Kons).

Conclusion

- Biohubs will play an essential role in a developed biomaterial market
  - Optimizing of raw material flows
- We need to develop
  - Business models
  - Design of biohub infrastructure
  - Management (IT) systems
  - …

IEA Bioenergy

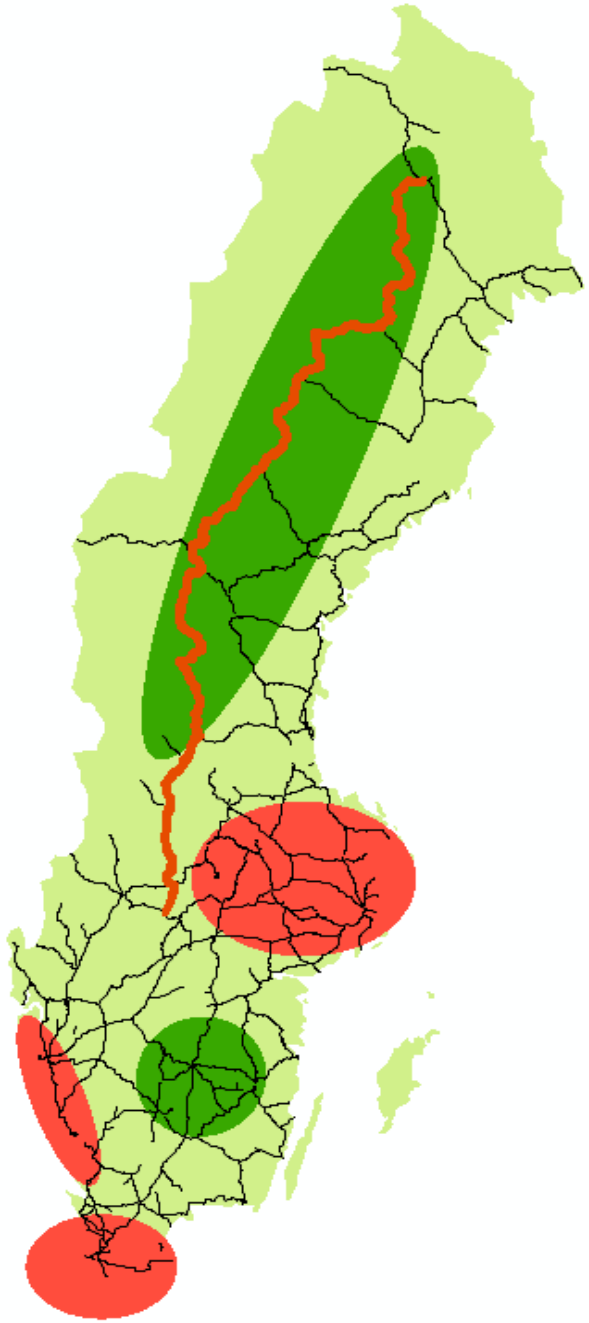
Contacts

Dan Bergström

Associate Professor

Swedish University of Agricultural Sciences, Department of Forest Biomaterials and Technology

dan.bergstrom@slu.se



Resources are allocated long distance from demand…