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NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

Wood resources for bioenergy

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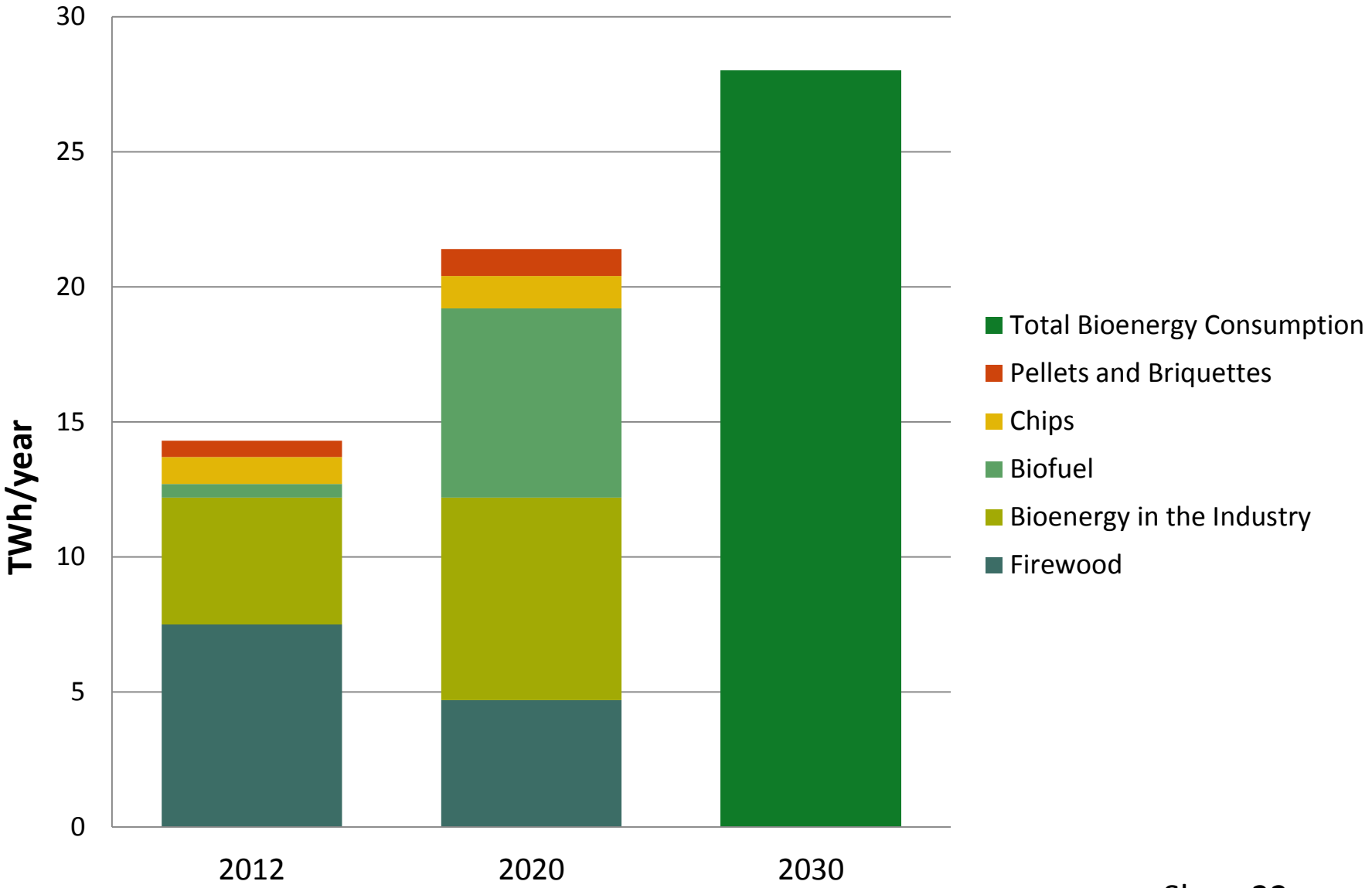
NIBIO's main areas of expertise:

Agriculture and plant health, environment and climate, surveys, land use, genetics, forestry, economics and social sciences

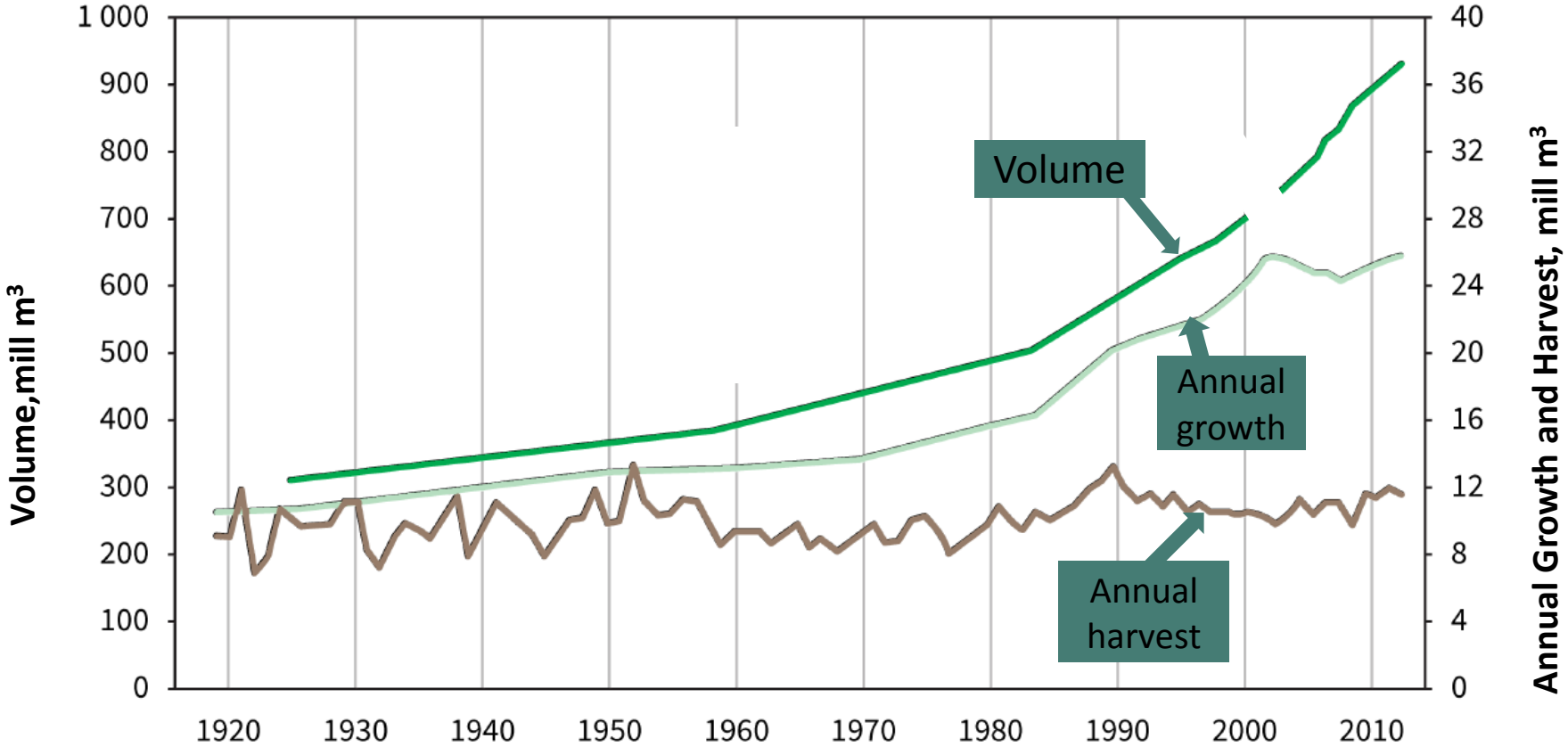
Covering Norway

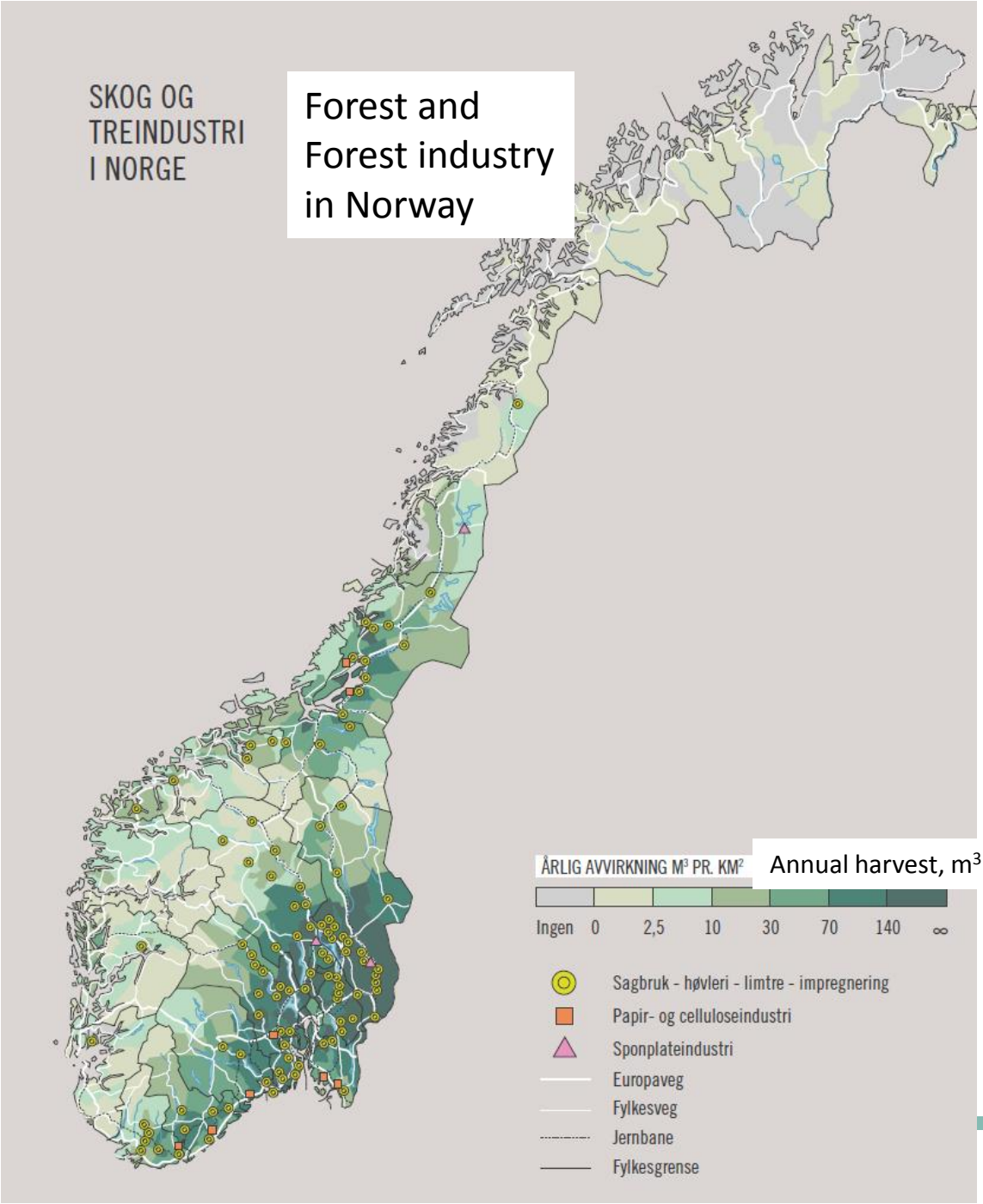
Bioenergy in Norway from Forest



Skog, 22

Volume, Growth and Harvest – Forest in Norway

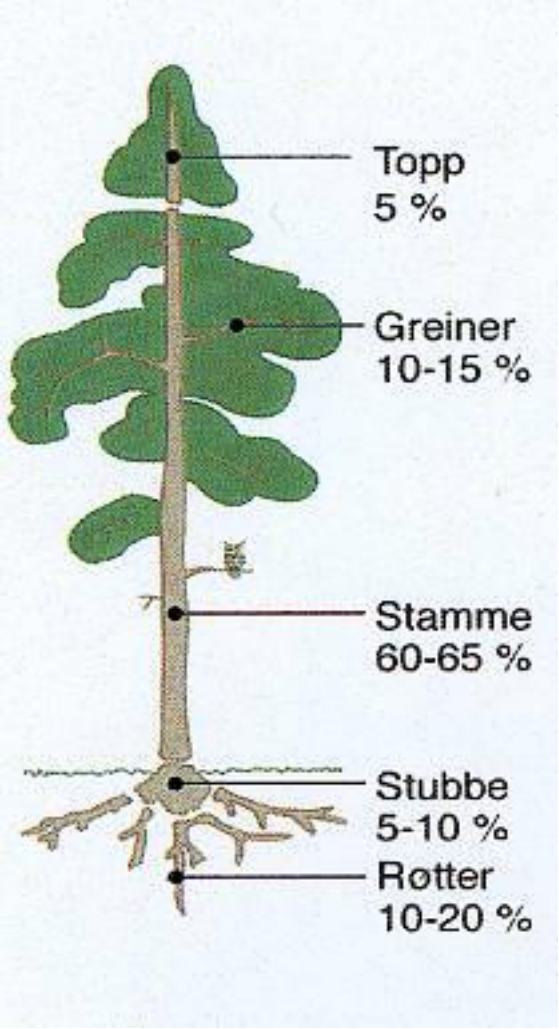




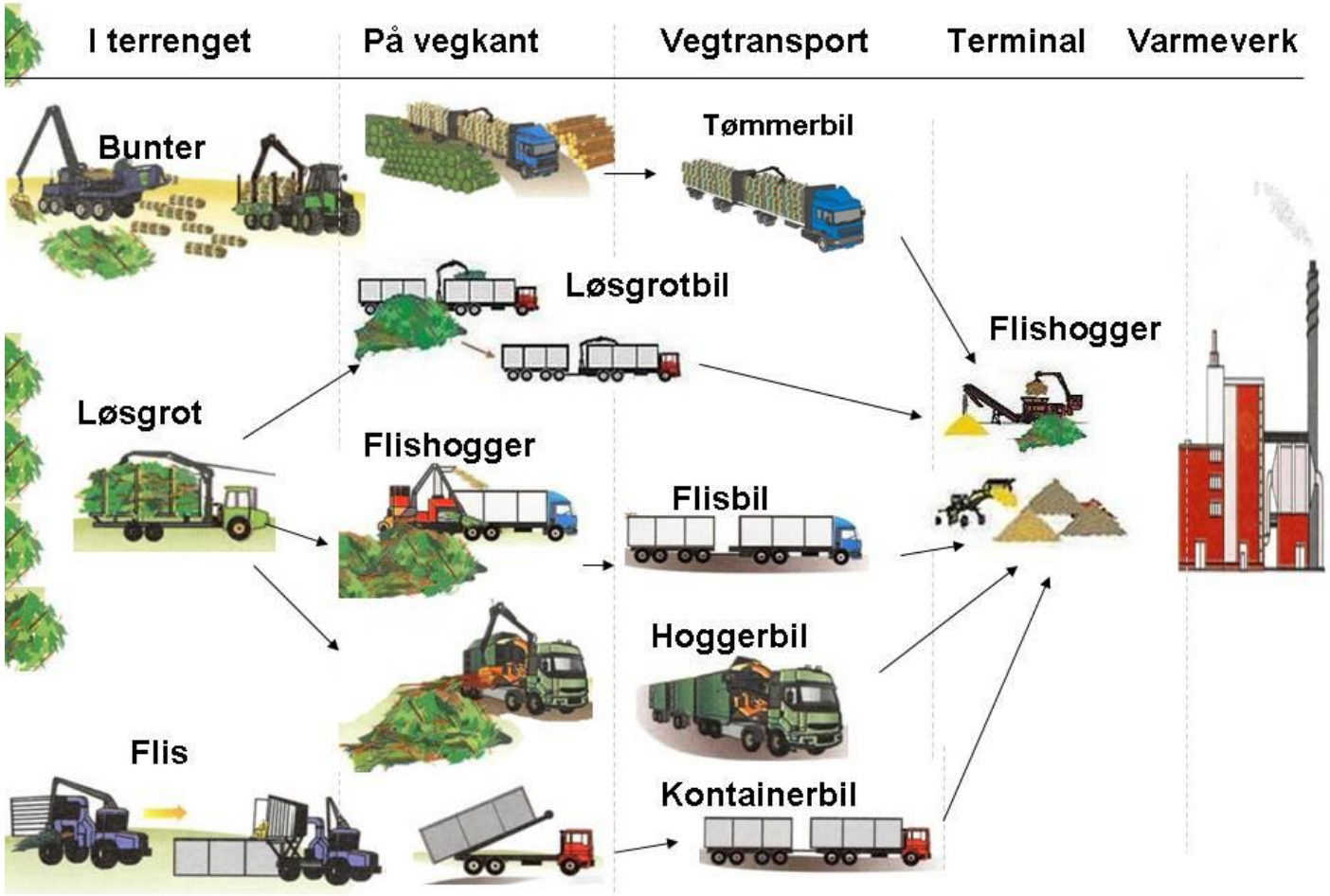
Rogaland, Hordaland, Sogn og Fjordane and Møre og Romsdal Harvest 21 % of the growth, while Østlandet harvet 56 %.

Skogsbrensel sortimenter

- Stammeved
- Heltre
- GROT (greiner og topper)
- Stubber



Supply chain configuration



25 % of forest in Norway in steep terrain

- The trees are harvested at the landing
- A lot of residues at the landing
- Handling of the residues is a challenge
- Storage and drying of residues is a challenge - it rains a lot in West-Norway
- No heating plants in Norway can utilize only forest residues

Photo: Dan Aamlid

Photo: Kjersti Holt Hansen

GROT

Forest residues (grot) is utilized to a very limited extent today.

- The subsidies has been removed
- Only from construction sites
- No heating plants can use only forest residues.
- The chips includes a lot fines
- High energy content
- Difficult to store

Photo: Leif Kjøstelsen

To much fines in grot!

Photo: Eirik Nordhagen

Forest road & chipping

Forest road terminals is not built for chipping!

Whole tree harvesting

The production is reduced to about 0.

- However some production from roadsides and to keep the landscape open
- Storage and drying of whole tree materials is ok!
- Good quality chips

Photo: Gunnhild Søgaard

Photo: Eirik Nordhagen

Terminals are important

- Most of the forest chips has been on a terminal
- The terminal has a covered storage
- Increases the chip quality
- More secure supply
- Efficient chipping and transport

Photo: Svein Skøien

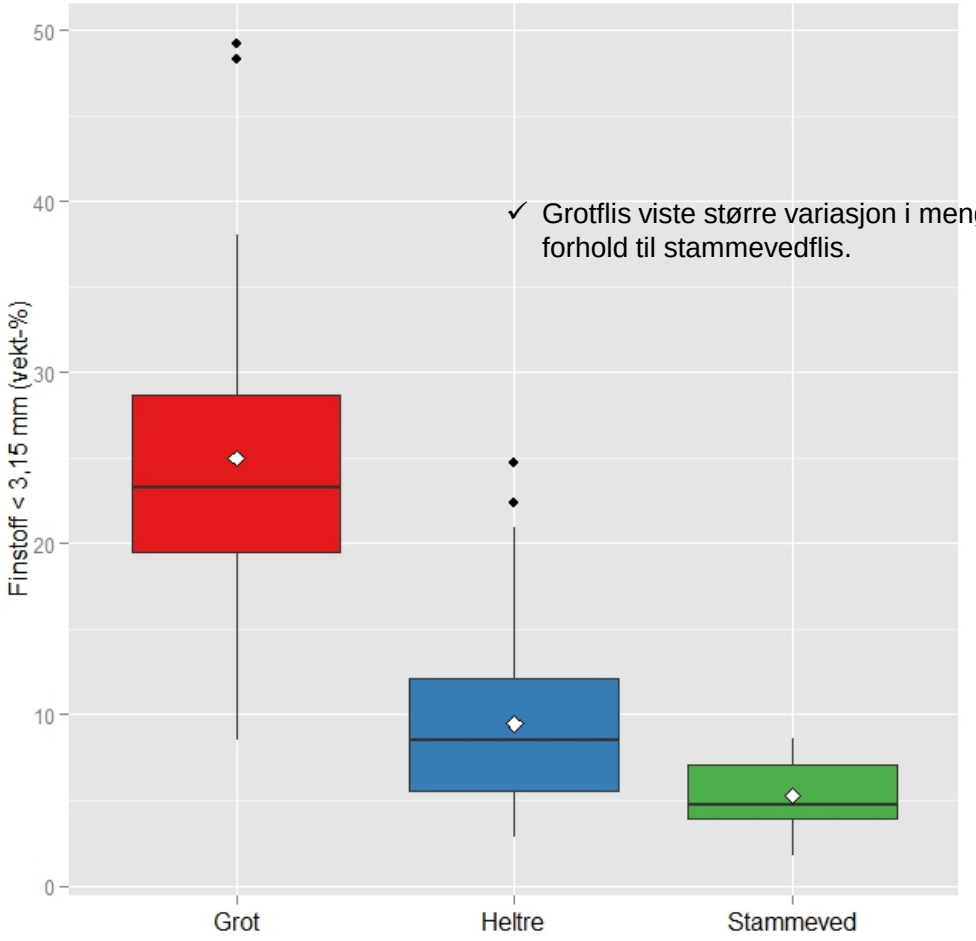
Photo: Eirik Nordhagen

Wood fuel quality, from forest to the oven

- Inherent properties of the tree
  - Spruce, Pine and Birch
  - Stem, bark, branches
- Moisture content
- density
- Particle size distribution (Fines)
- Heating value
- Ash (amount, chemical content, melting point)
- Chemical content

Photo: Leif Kjøstelsen

Fin fraksjonen



- ✓ Grotflis viste større variasjon i mengden av finstoff i forhold til stammevedflis.

Fuktighet i flismaterialet

Råstoff	Fuktighet (vekt-%)	sd	n
Stammeved	39.0	8.9	37
Heltre	39.9	9.5	46
Grot	49.8	8.0	19
Bakhon	39.3	9.8	4
Bark	69.9	NA	1
Stubber	50.6	NA	1

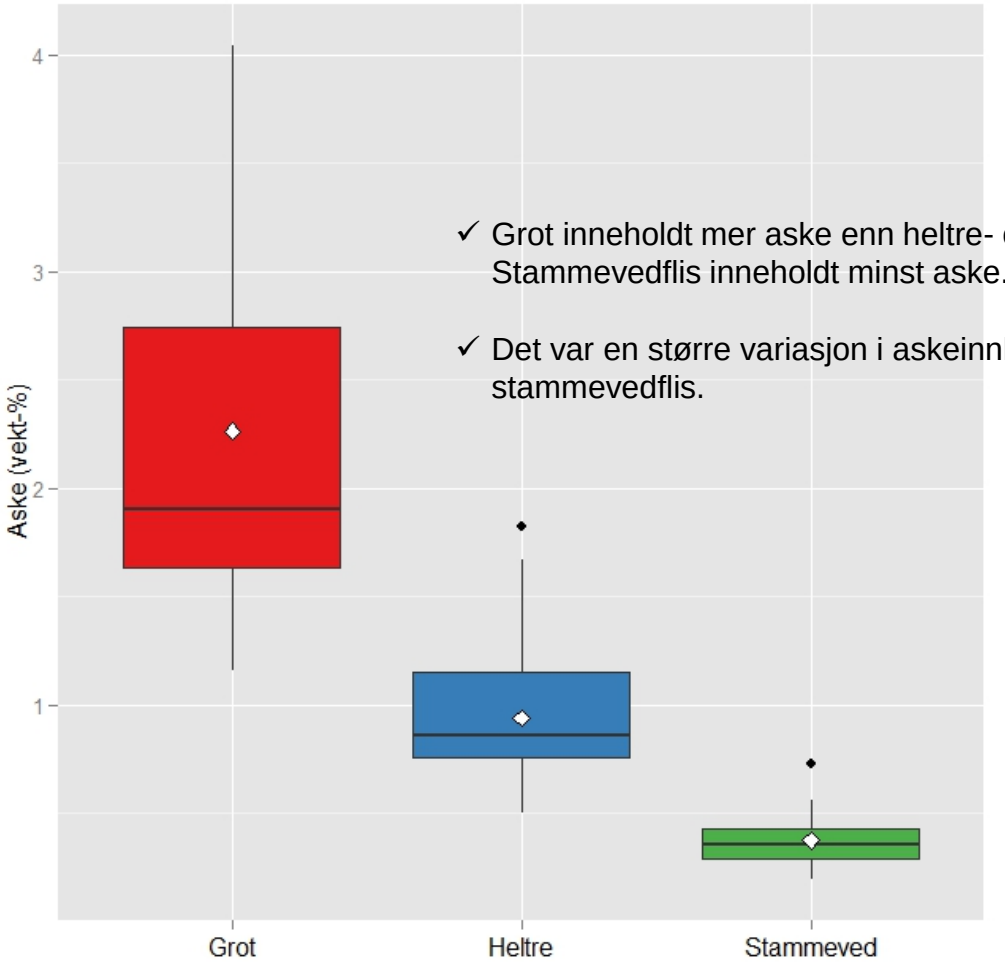
Grot fuktigere enn heltre og stammeved.

Energitetthet

Råstoff	Energitetthet (kWh/lm³)	sd	n
Stammeved	753	47	25
Heltre	791	77	40
Grot	826	89	15
Bakhon	801	86	3
Bark	490	NA	1

Høyeste energitetthet (1048 kWh/lm^3) ble beregnet på grot med en fuktighet på 39,8 %.

Askeinnhold



- ✓ Grot inneholdt mer aske enn heltre- og stammevedflis . Stammevedflis inneholdt minst aske.
- ✓ Det var en større variasjon i askeinnhold i grot enn i stammevedflis.

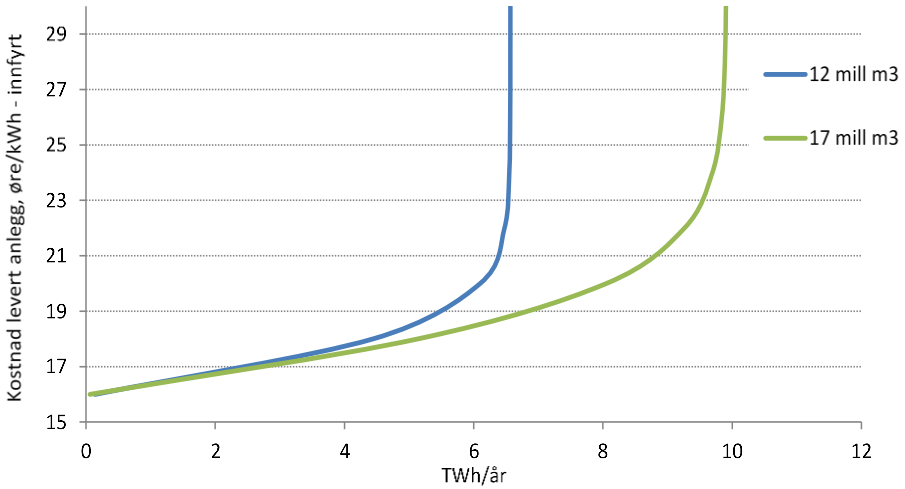
Annual utilization of grot in Norway

Costs for production of chips from GROT: ≥ 16 øre/kWh

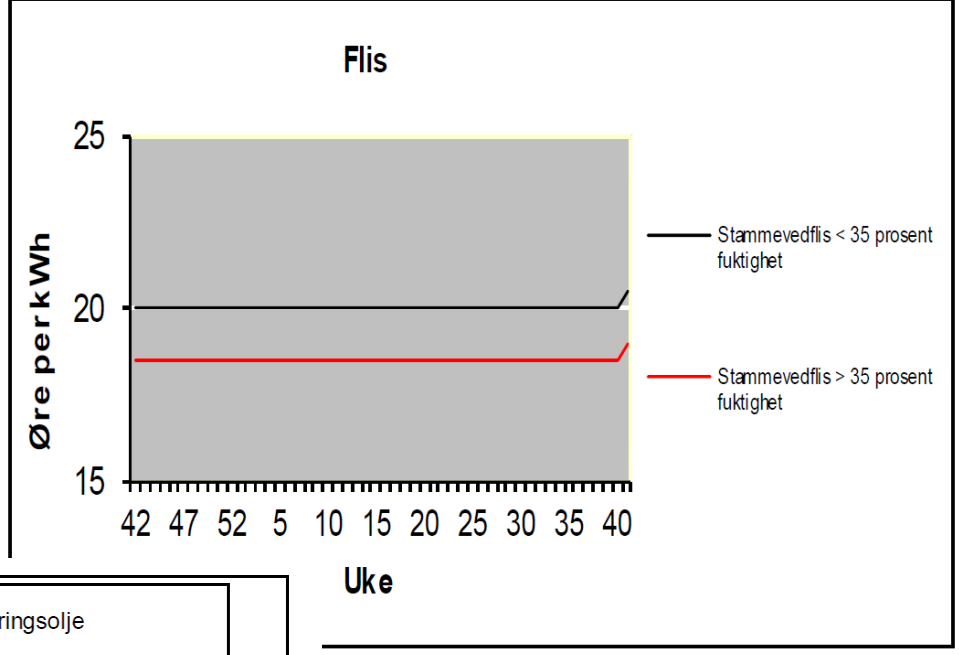
Harvest of grot: costs ≤ 30 øre/kWh:

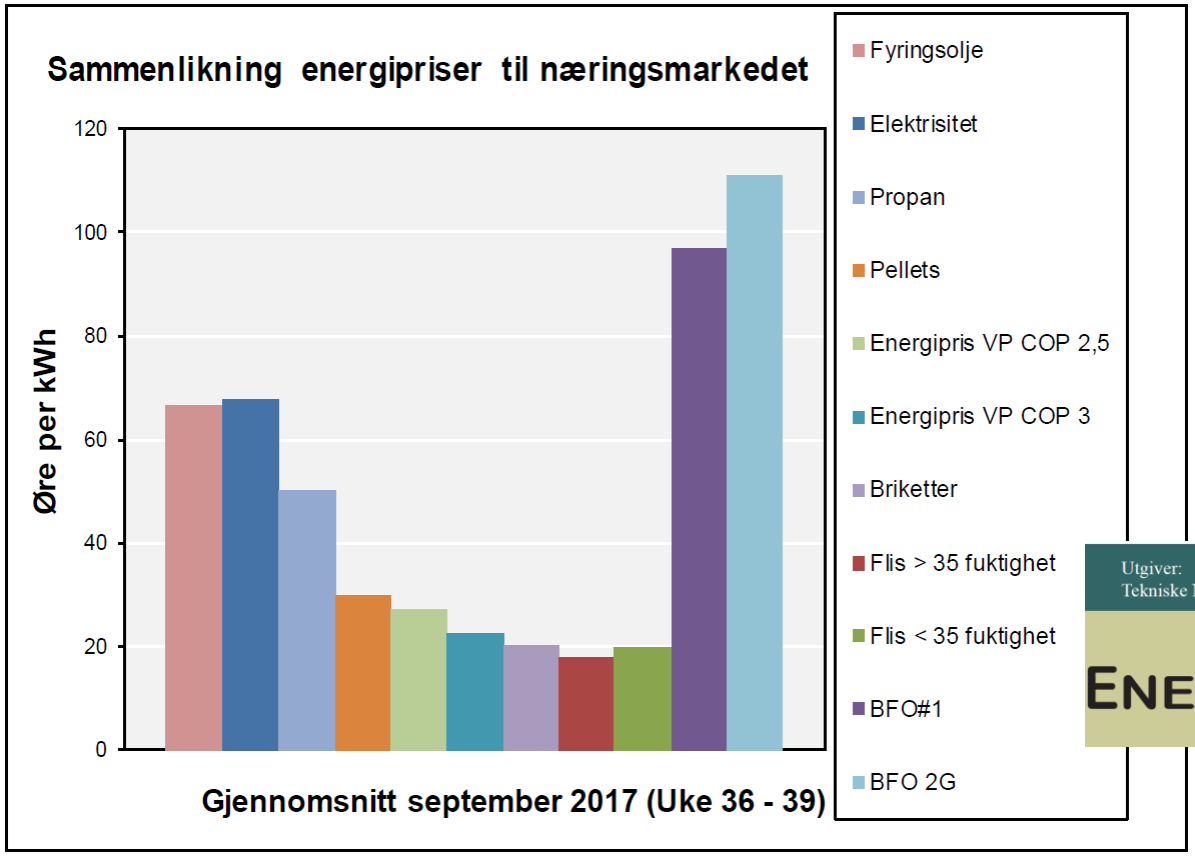
- 12 mill m^3 → ca 7 TWh/år
- 17 mill m^3 → ca 10 TWh/år

	øre/kWh	Kr/lm³
Payment to landowner	2,9	25
Administration	2,0	17
Chipping and expenses to terminal	6,6	57
Roadtransport	2,8	24
SUM	14,3	123
Terrain transport	>2,0	>17
Total	>16,3	>140

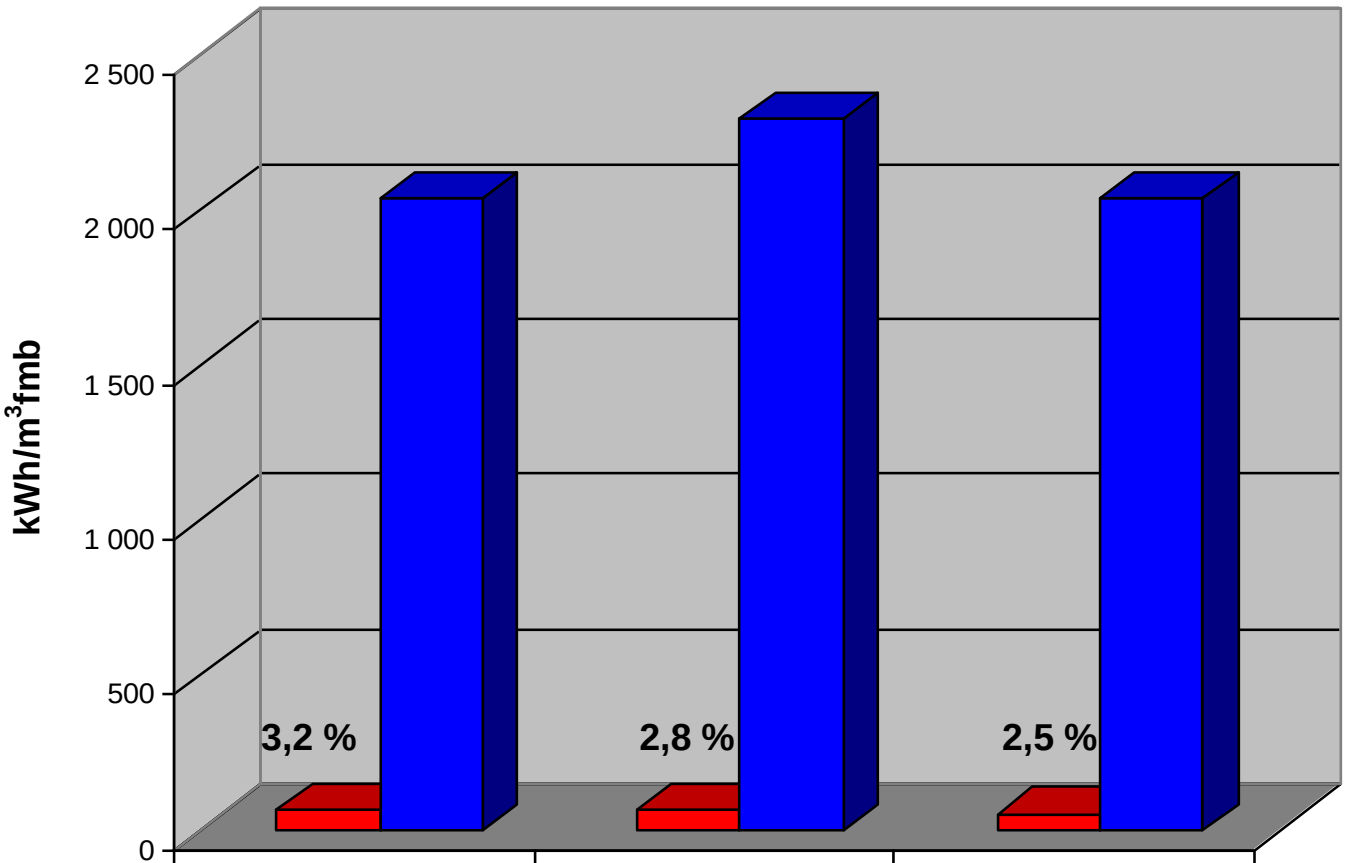


Energyprices





Energiforbruk ved høsting av skogsbrensel

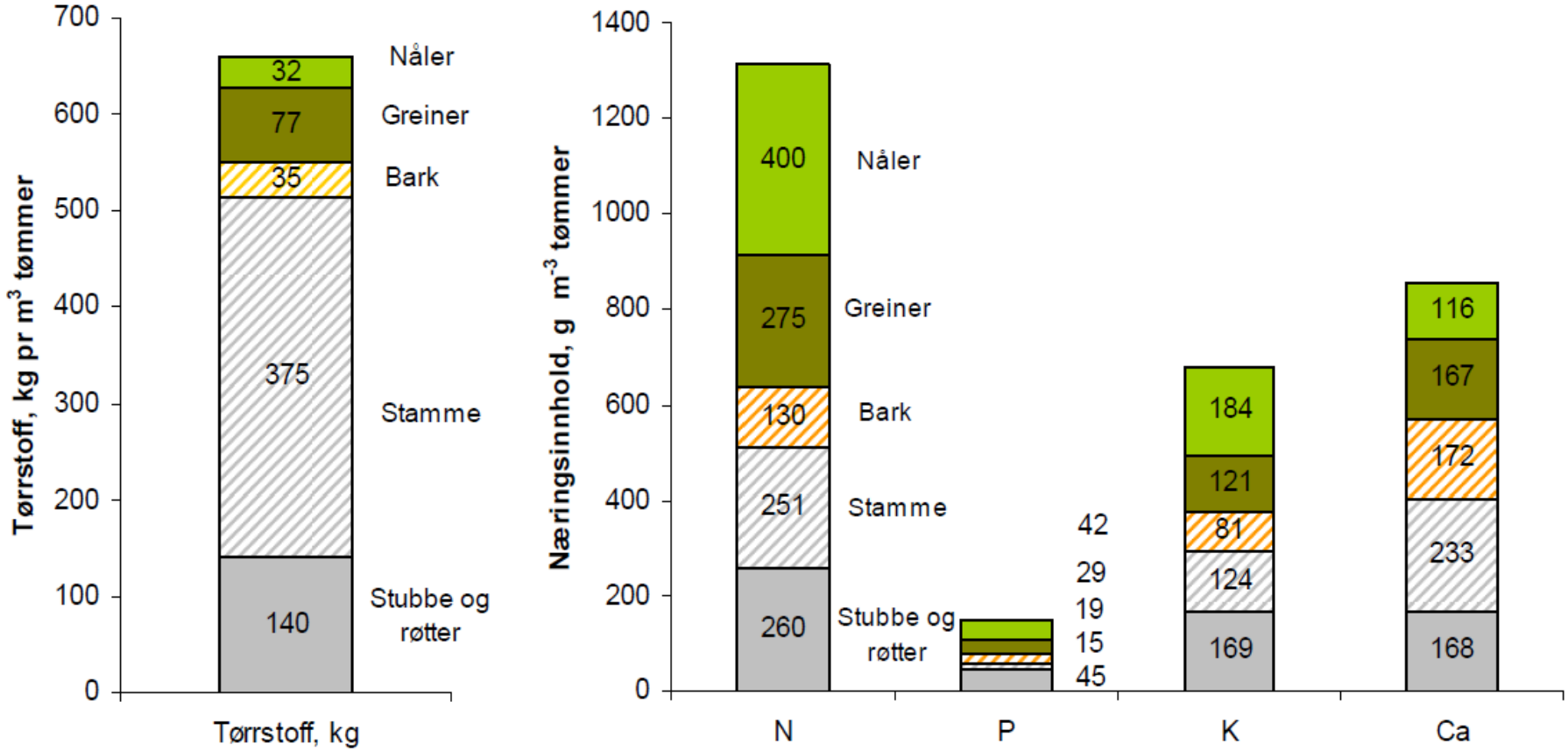


	Stammeved	Heltre	GROT
Input	66	63	52
Output	2 035	2 298	2 035

Some thougts…

- The last ten years more than 2 mill m^3 with chips annualy to heating plants.
- Woodresources have changed from grot and whole trees to stemwood.
- In the future biofuel from wood (and heat and power).

Næringsfordeling i treet



45 år gammelt furubestand. Etter E. Mälkönen (1976)

Kjersti H. Hanssen

Askeegenskaper

- Elementsammensammensetning
  - Næringsstoffer (Ca, Mg, K, P, Na)
  - Tungmetaller (Cu, Pb, Cd, Hg,...)
- Partikkelstørrelse og tetthet
- Innhold av organisk karbon og forurensende organiske forbindelser
- Utlakingsegenskaper
- pH