Energy from conventional forestry in Sweden – concerns and research approaches for environmental effects and forest production

Helene Lundkvist, Prof., SLU-Swedish University of Agricultural Sciences
Hillevi Eriksson, Climate Expert, Swedish Forest Agency
Bengt Olsson, Assoc. Prof., SLU-Swedish University of Agricultural Sciences

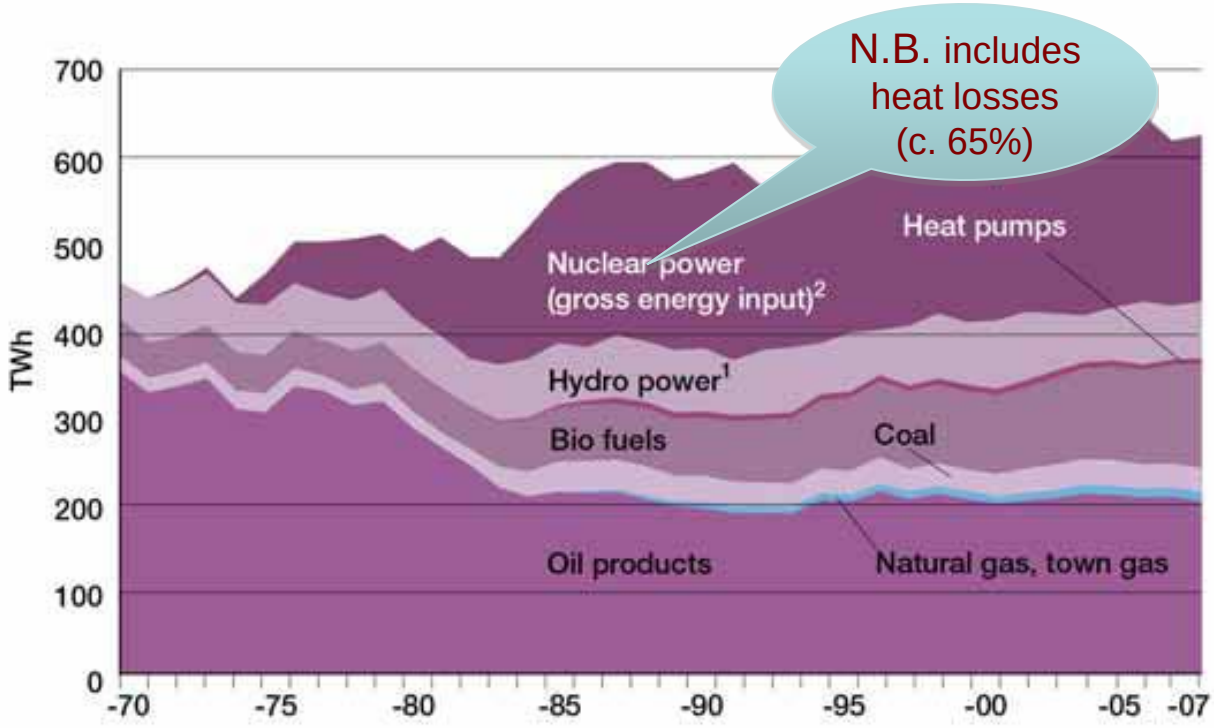
Presented by
Lisa Sennerby-Forsse, Prof., Vice Chancellor, SLU


Sweden

Milestones of bioenergy development in Sweden

- Oil crisis 1973
- Referendum 1980; no to more nuclear power
- 1992 – new environmental taxes on fossil fuels for reduction of CO_2
- Present - Climate change concerns;
  EU's climate agreements

Total energy use in Sweden 1970-2007, excluding net electricity export



SOURCE: STATISTICS SWEDEN, ADDITIONAL PROCESSING BY THE SWEDISH ENERGY AGENCY

1. INCLUDING WIND POWER UNTIL 1996.
2. CALCULATED IN ACCORDANCE WITH THE UN/ECE METHOD FOR ENERGY SUPPLY FROM NUCLEAR POWER.

Bioenergy in future

Increased pressure on Swedish bioenergy

- Nationally through further development of biorefineries
- From other EU-countries – due to decisions on renewables in the European energy system

Sweden

27 million ha forest;

Norway spruce	45%
Scots pine	38%
Birch	10%

c. 200 000 ha harvested annually

- Felling residues harvested (i.e. whole tree harvesting, WTH) from c. 25-30%
- Stumps harvested from c. 1-2%
- Wood ash recycled to c. 5%

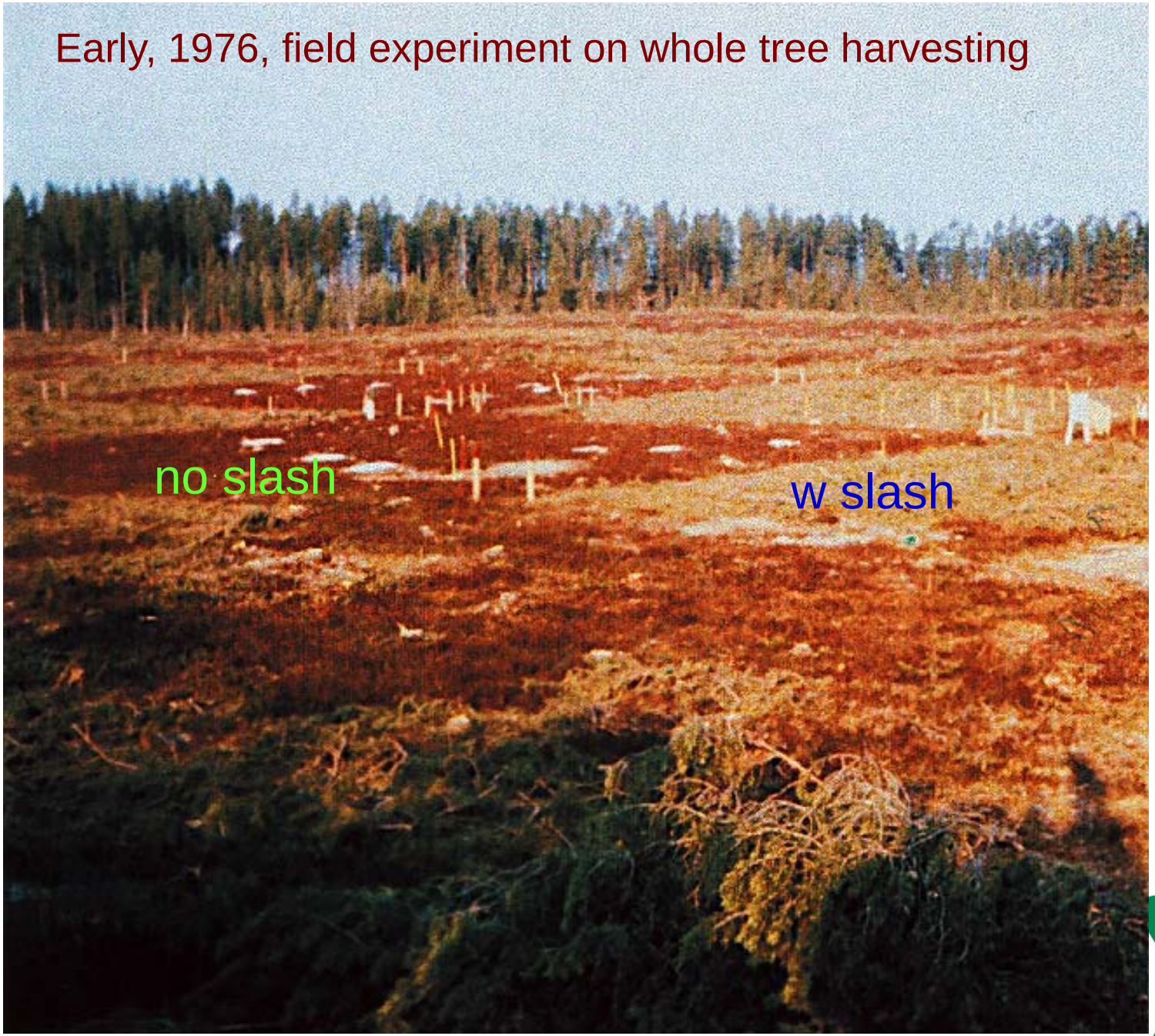
Whole tree thinning operation

Forest energy contributes 25% of the total Swedish energy supply
Research on production, harvesting, logistics, environmental effects, economy, systems…….


Whole tree thinning


conventional
thinning

Early, 1976, field experiment on whole tree harvesting



On site storing of felling residues

Stump harvesting

Photo: Johan Karlsson

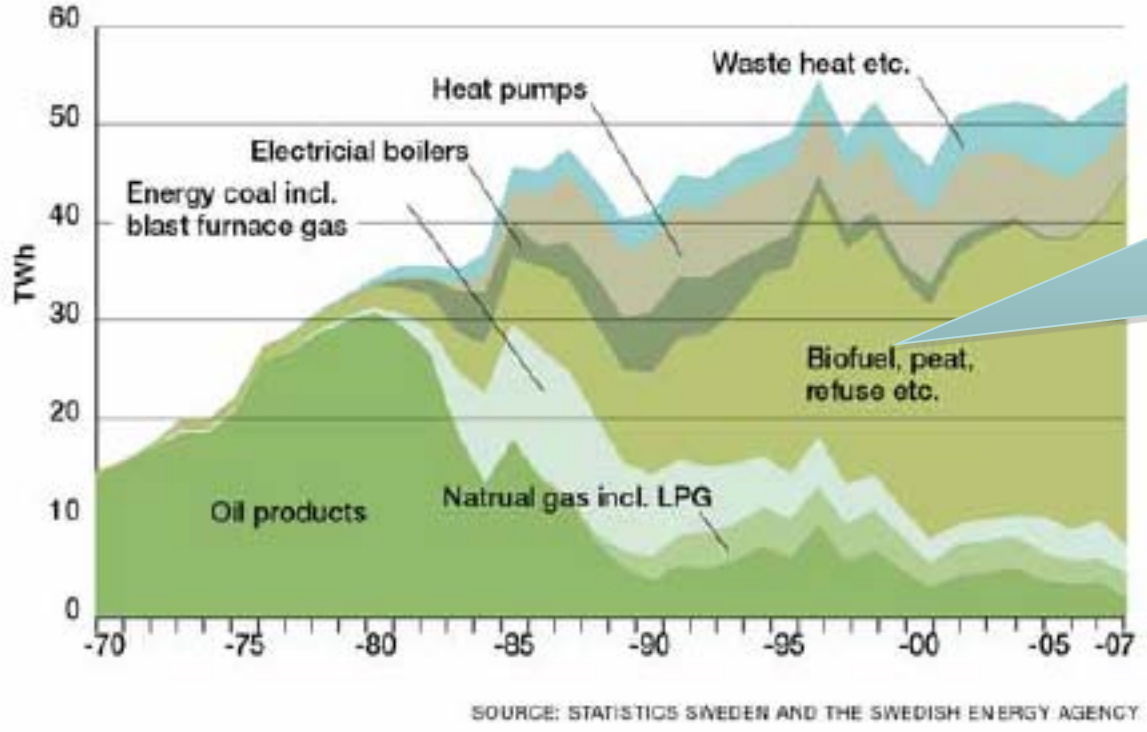
– investigations of effects on soil and water environment, biodiversity, and carbon budgets

Chipping of bundles at terminal

…pellets storage

Bioenergy combines - efficient flows of biomass and energy

Energy input to district heating systems 1970-2007



N.B. increase in large scale district heating AND in use of bioenergy

Bioenergy from forests - Environmental concerns

Dominating focus of research programs on environmental consequences of intensive harvesting in conventional forestry

1. Nutrient losses -70'ies – present
2. Base cation losses -80'ies – present
3. Biodiversity losses -90'ies – present
4. Climate change issues -90'ies – present

Effects of whole-tree harvesting on soils compared with stem-only harvesting

- **Soil carbon stores**: Field studies of experiments show no discernable effects, but ecosystem models predict small or moderate carbon depletion in soils over a rotation period or more.

- **Soil acid-base status**: increased harvesting of base cations acidify humus and mineral soils: can last for more than two decades

- **Rationale for wood-ash recycling**: Recycling of hardened wood-ash is considered a major method to compensate for base cation and phosphorus losses

- Some key papers:
  - *Olsson, B. et al. 1996. Forest Ecology and Management vol. 82 and vol. 84*
  - *Bengtsson & Wikström (1993) N.Z. J. For. Sci. Vol 23*
  - *Ågren & Hyvönen (2002) Forest Ecology and Management 5886: 1-13*

Hardened wood ash, two types, for recycling of base cations and nutrients to forest soil

Effects of whole-tree harvesting on forest growth

WTH at final felling can cause growth reduction in the next rotation
- especially for Norway spruce

WTH at thinnings can lead to growth reductions for both Scots pine and Norway spruce

Growth reductions most likely caused by reduced N availability (conclusion based on factorial fertilization experiments)

Swedish key papers on forest growth:
WTH at final fellings:
Egnell G & Leijon B (1999) Scand J For Res Vol 14
Egnell G & Valinger E (2003) For Ecol Manage Vol 177

WTH at thinnings:
Egnell G & Leijon B (1996) Scand J For Res Vol 13
Jacobson S et al. (1996) Scand J For Res Vol 11

Effects of whole-tree and stump harvesting on biodiversity

WTH affects soil organism population sizes and species composition

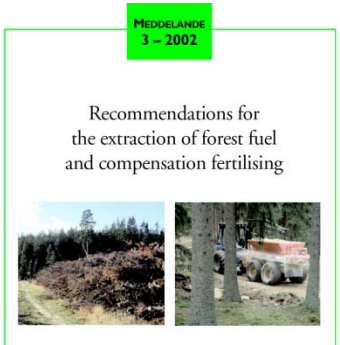
Amount and quality of felling residues and stumps left on site are important for wood dependent organisms like insects, lichens, mosses

Picture from A. Dahlberg

Recommendations (revised 2008)
from The Swedish Forest Agency

- Preserve biodiversity
- Prevent acidification and nutrient depletion of soil and run-off water
- Use the ash for recycling correctly
- Limit driving damages on soils and trees and prevent insect damages
- Documentation, rules and contacts with authorities

The recommendations are based on legislation;
The Forestry Act
The Environmental Code
The Heritage Conservation Act



Thank you!