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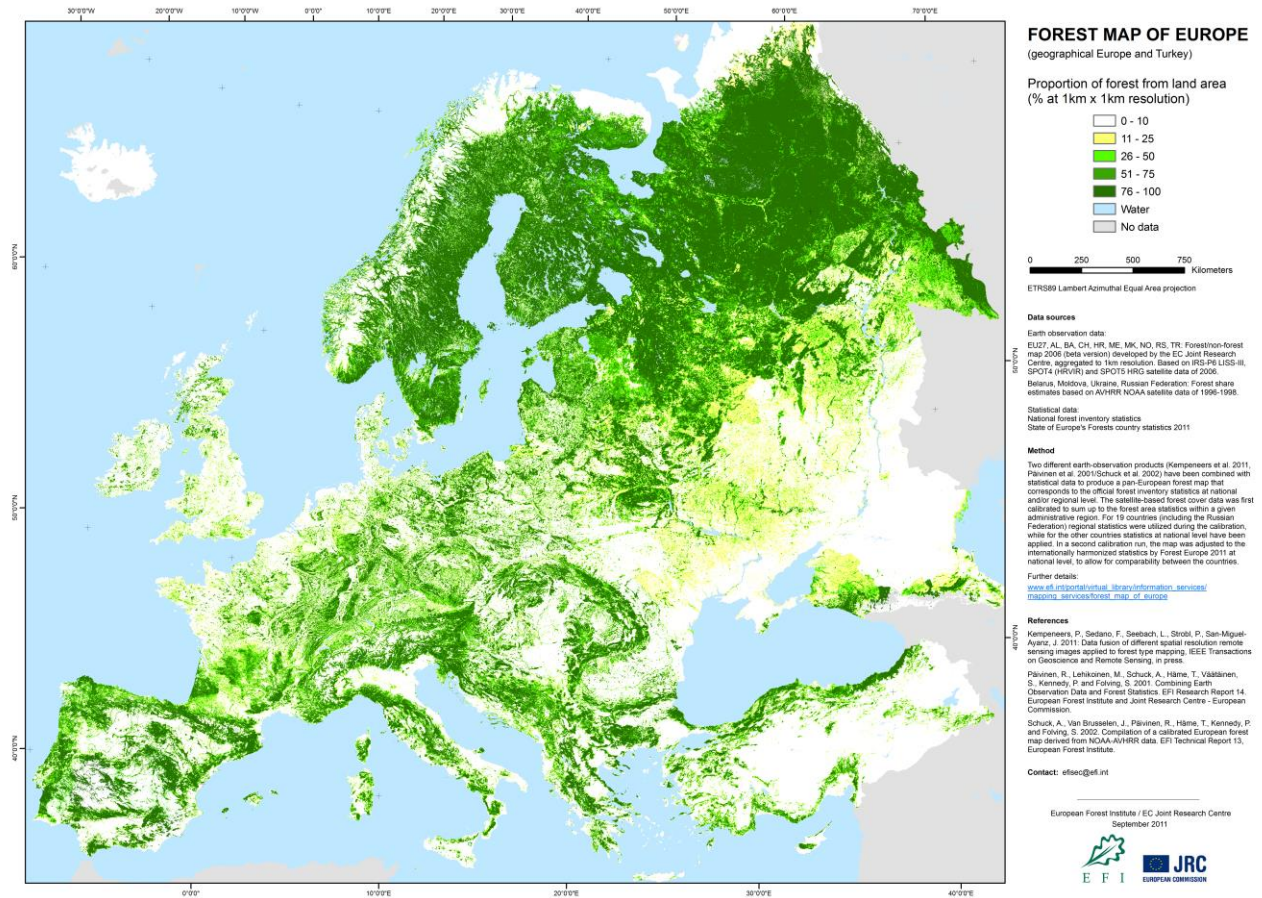
NORWEGIAN INSTITUTE OF
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Environmental sustainability in the circular bioeconomy: the case of forest-based bioenergy in the Nordic countries

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Forests occupy a large part of the Nordic countries and could be used for bioenergy production



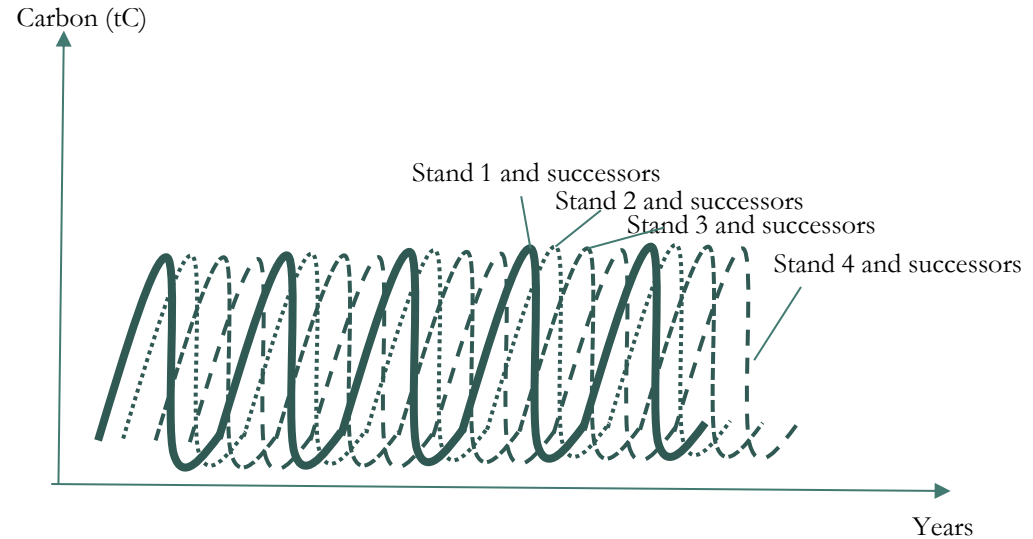
Source: European Forest Institute. Based on Kempeneers, P., Sedano, F., Seebach, L., Strobl, P., San-Miguel-Ayanz, J. 2011: Data fusion of different spatial resolution remote sensing images applied to forest type mapping, IEEE Transactions on Geoscience and Remote Sensing; Päivinen, R., Lehtiköinen, M., Schuck, A., Häme, T., Väätäinen, S., Kennedy, P., & Folving, S., 2001. Combining Earth Observation Data and Forest Statistics. EFI Research Report 14. European Forest Institute, Joint Research Centre - European Commission. EUR 19911 EN. 101p.; Schuck, A., Van Brusselen, J., Päivinen, R., Häme, T., Kennedy, P. and Folving, S. 2002. Compilation of a calibrated European forest map derived from NOAA-AVHRR data. EFI Internal Report 13, 44p. plus Annexes.

Increased use of forest biomass for bioenergy has to be ecologically sustainable

- How can this be ensured?
- Use of residues (previously considered ‘waste’)
- What are the risks involved?
- How can these be managed?

The carbon cycle

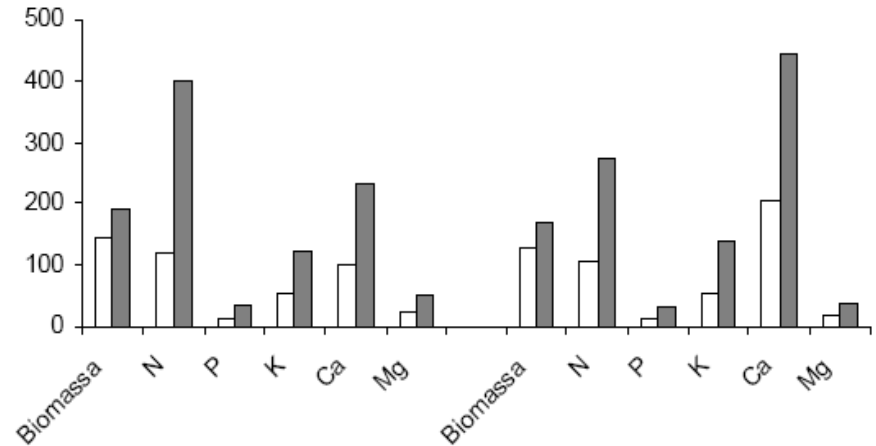
- Above-ground biomass largely removed during final felling, but much used in e.g. construction
- Soil carbon stocks often reduced
- Total carbon stock at landscape level should not be reduced



Schematic pattern of felling, reforestation and succession required to keep the carbon stock from declining (source: Hansen Economics)

Nutrient cycles

- Risk for site nutrient depletion when harvesting tree branches and tops
- Needles/leaves should be left on-site
- Compensatory fertilisation possible



Biomass removal (ton/ha) and nutrient removal (kg/ha) after stem-only harvesting (white columns) and whole-tree harvesting (grey columns) in two Swedish spruce stands (Swedish Energy Agency 2006)



Photo: Kjersti Holt Hanssen

Terrain damage

In steep terrain and where carrying capacity is low, there is risk for terrain damage: risk for increased erosion, soil compaction and vegetation damage

Biodiversity

- Saproxylic insects, lichens and fungi that live on branches, dead wood etc. at risk if branches and tops harvested
- Changes in ground vegetation after harvesting: Will ground vegetation return to its pre-harvest state? Need for refuges and corridors
- Insufficient knowledge as only few case studies



Photo: Ingvald Røeberg

Governance aspects

- RED
- National legislation
- Forest Europe's criteria and indicators
- Certification systems at forest management unit level (FSC, PEFC)
- Risk assessment of sourcing at regional level: supply base evaluation, e.g. for pellet producers (SBP)
- One size does *not* fit all: local adaptation and acceptance necessary
- Need for local experts

Conclusions

- Necessity for environmental sustainability is generally accepted
- Challenges/risks if increased use of forest for bioenergy, but these are (probably) manageable
- Good governance necessary, e.g. in certification systems, or alternatives such as supply base evaluations
- Local acceptance needed



Photo: NIBIO



Photo: Kjersti Holt Hanssen



Photo: Pix Gallery



Photo: Annelunds gård

Thank you for your
attention