

Forest

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# Effects of forest management on carbon storages – scenario analysis

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# Scenario analysis – aim and scope

- To assess the potential, cost-efficiency and impacts of intensive management of Finnish forest resources
- To identify sustainable, cost-efficient and feasible ways to increase the production of domestic biomaterial with high utility value for current and future forest and energy industry
- This presentation focuses on the effects of forest management on carbon storages



# Assumptions and restrictions

- Time span of scenarios is 100 years
- The areas of protected forests will remain at the current level
- Steady supply of wood and biomass: Temporal variation between 10-year periods was evened out
- Sustainability of wood production: Volume of the growing stock at the end of 100-year period must be at minimum ca 80 % of the initial volume



# Scenarios for alternative management and utilization of Finnish forest resources

## *Business as usual (BAU)*

- Operational environment
  - the role and importance of forest-based industry will remain at current level in the future
  - ongoing trends in forest sector are assumed to occur as expected
  
- Management of forest resources
  - Intensity of forest management will remain at current level
    - silvicultural practices are completed on 54 % of forest area recommended to be managed
    - annual cuttings are 78 % of sustainable allowable cut

# Scenarios for alternative management and utilization of Finnish forest resources

## *Intensive production of high quality raw material for forest industry and bioenergy (QLTY)*

### ■ Operational environment

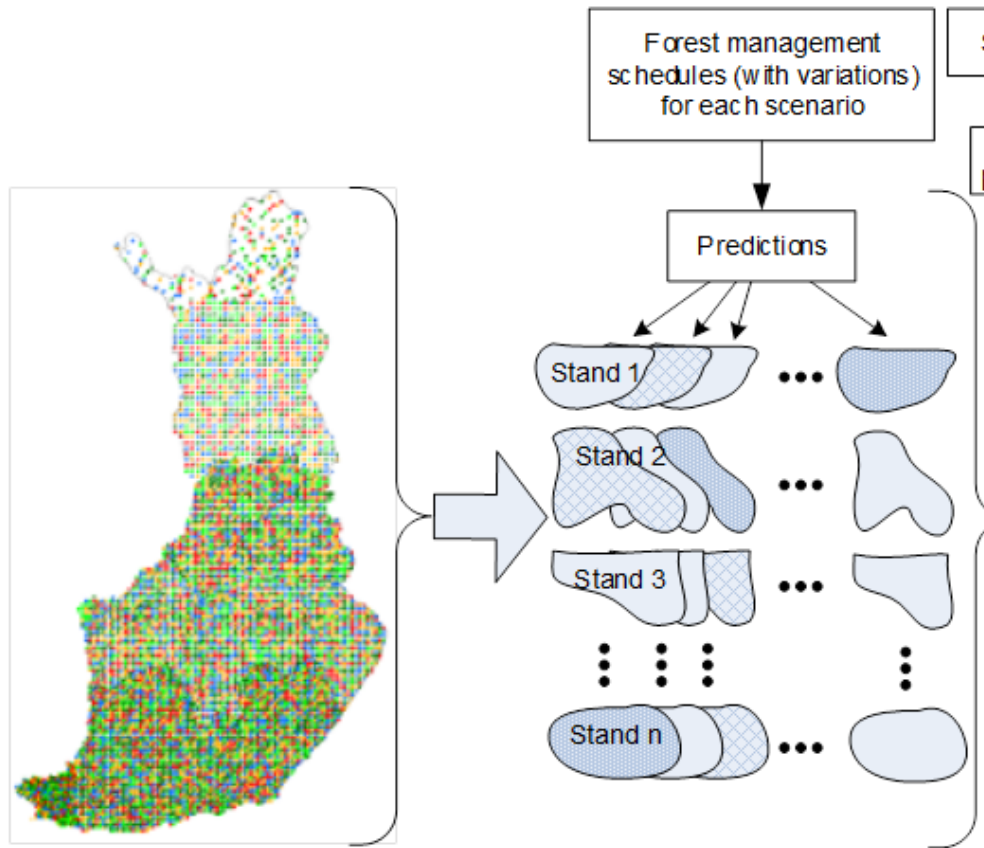
- increasing demand for high quality raw material of forest and energy industry (especially wood products & forest-based bioenergy)

### ■ Management of forest resources

- Intensive forest management measures are widely applied
  - intensive regeneration and young stand management practices
  - wood quality aspects are emphasized in forest management
    - high density of young Scots pine stands
    - thinnings for quality
    - longer rotations
  - combined energy wood and timber production
    - combined energy and pulp wood recovery in first commercial thinnings
    - biomass recovery in final fellings: logging residues and stumps

# Methods

# Calculation procedure of scenarios



Forest resources represented by NFI-sample plots > 40 000 stands

Automated simulation of alternative management regimes for each stand with MOTTI-simulator

# MOTTI stand simulator

Salminen et al. (2005), Hynynen et al. (2005)

**INITIALIZATION**

**Settings**  
Timber assortments

**Initialize a stand**  
Initialize  
Open  
Open xforest-file

**SIMULATION**

**Management practice**  
Growth - 5 year  
Cleaning of sapling stand  
Precommercial thinning  
Removal of seed-trees  
Thinning  
Final cut  
Fertilization  
Supplementary ditching  
High pruning

**Management schedule**  
Define and grow

**RESULTS**

Yield  
Economy  
Graphs  
Reports  
Yasso

**CONTROL**

New simulation  
Initialize new stand  
Close

**HELP**

Manual  
w/w/w

**ASETUKSET**

DLL - valinnat  
Taulukkolaskin  
Versiot  
Harvennusohjelmat  
Lahopuu

aulukkolaskin i G

apahu-indeksi: hpm

rowth model

## ■ A stand-level analysis tool

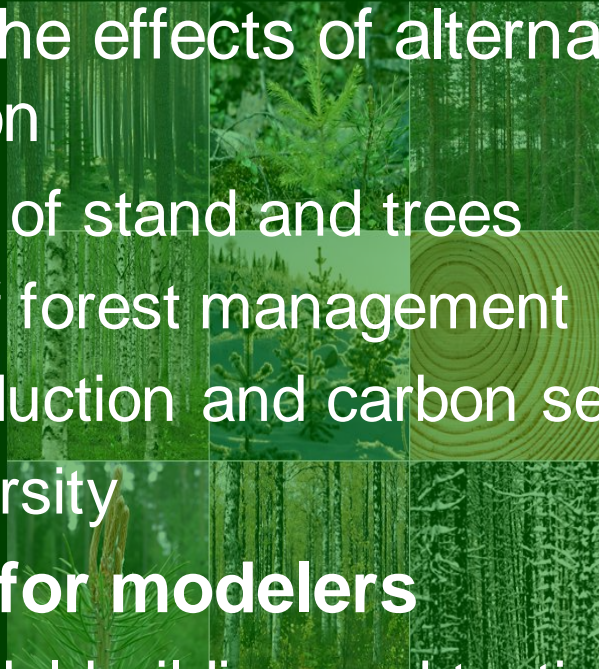
for assessing the effects of alternative forest management on

- development of stand and trees
- profitability of forest management
- biomass production and carbon sequestration
- forest biodiversity

## ■ A workbench for modelers

- a tool for model building and testing

## ■ A support tool for stand-level decision making





# MOTTI- a stand-level decision system

## User-defined input

Stand inventory data

Management options

Timber assortment criteria

Logging parameters  
- applied machinery  
- unit costs

Economical parameters

Request for reports

## Stand simulation

Prediction of stand dynamics in varying growth environment including the

- impact of environmental chances
- impact of forest management practices
- impact of genetic gain

Regeneration - Growth - Mortality

## Analysis

Yield

Wood quality

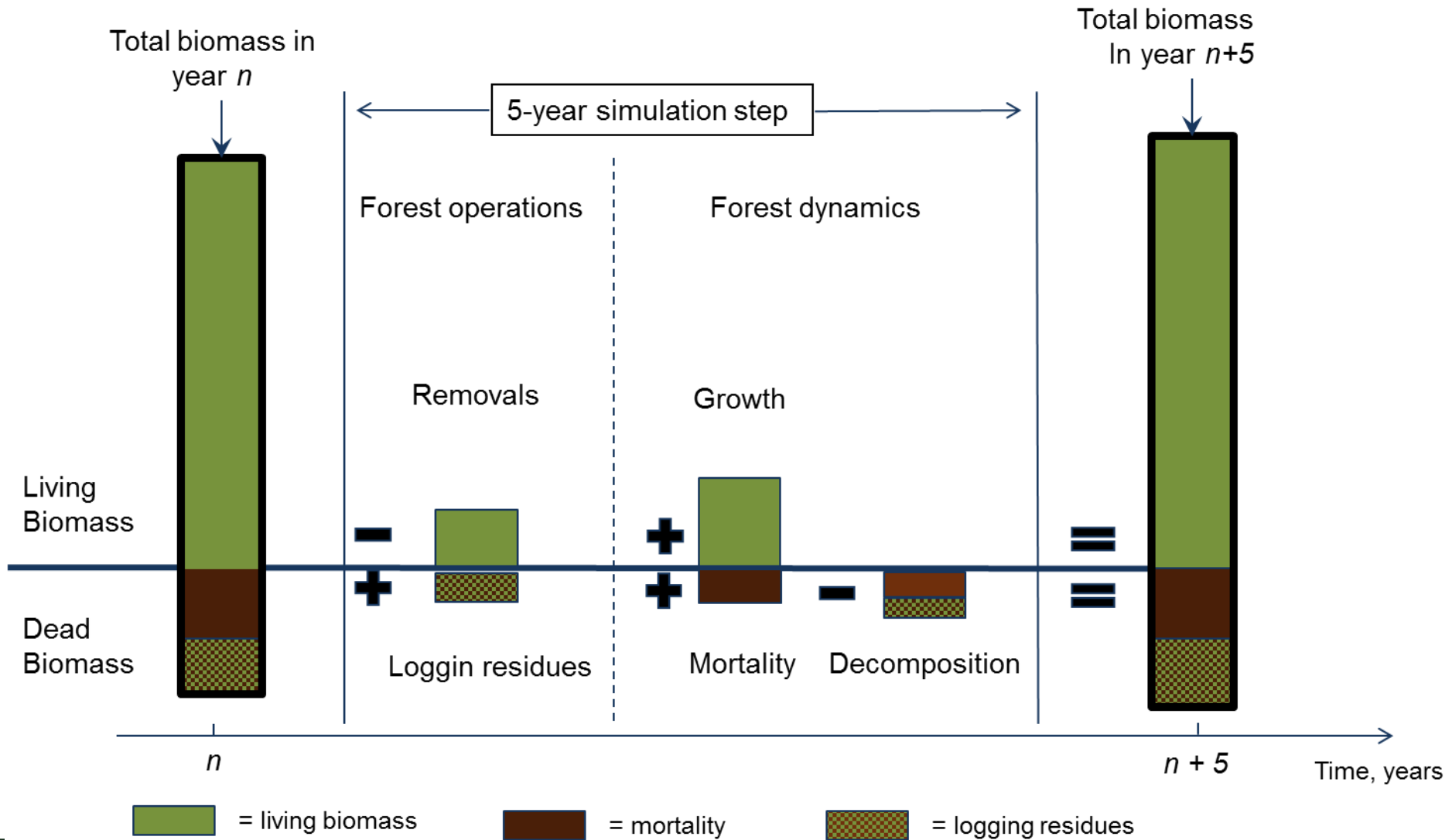
Carbon  
- sequestration  
- footprint

Forest economics

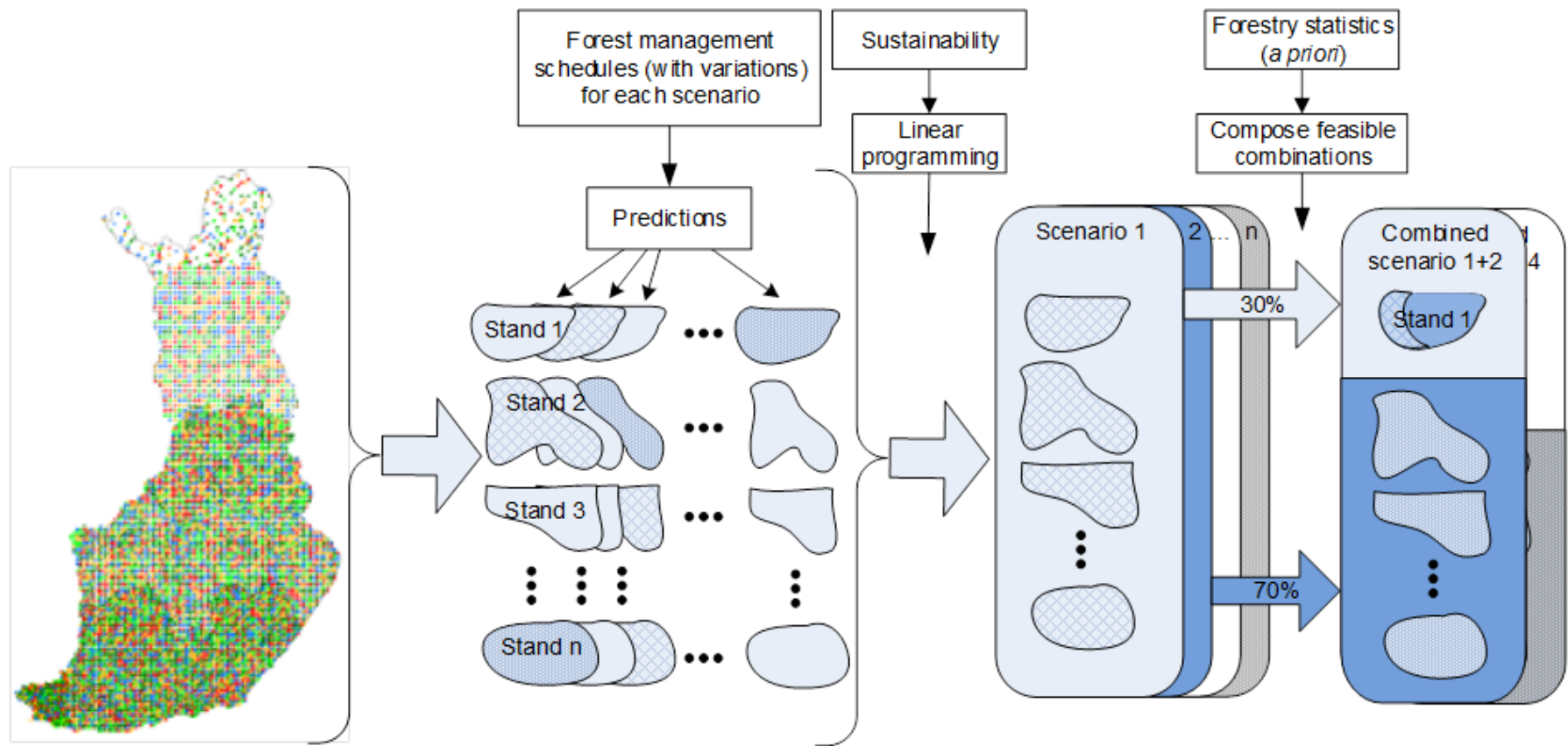
Biodiversity

## Output of the results

# Estimation of stand biomass



# Calculation procedure of scenarios



Forest resources represented by NFI-sample plots > 40 000 stands

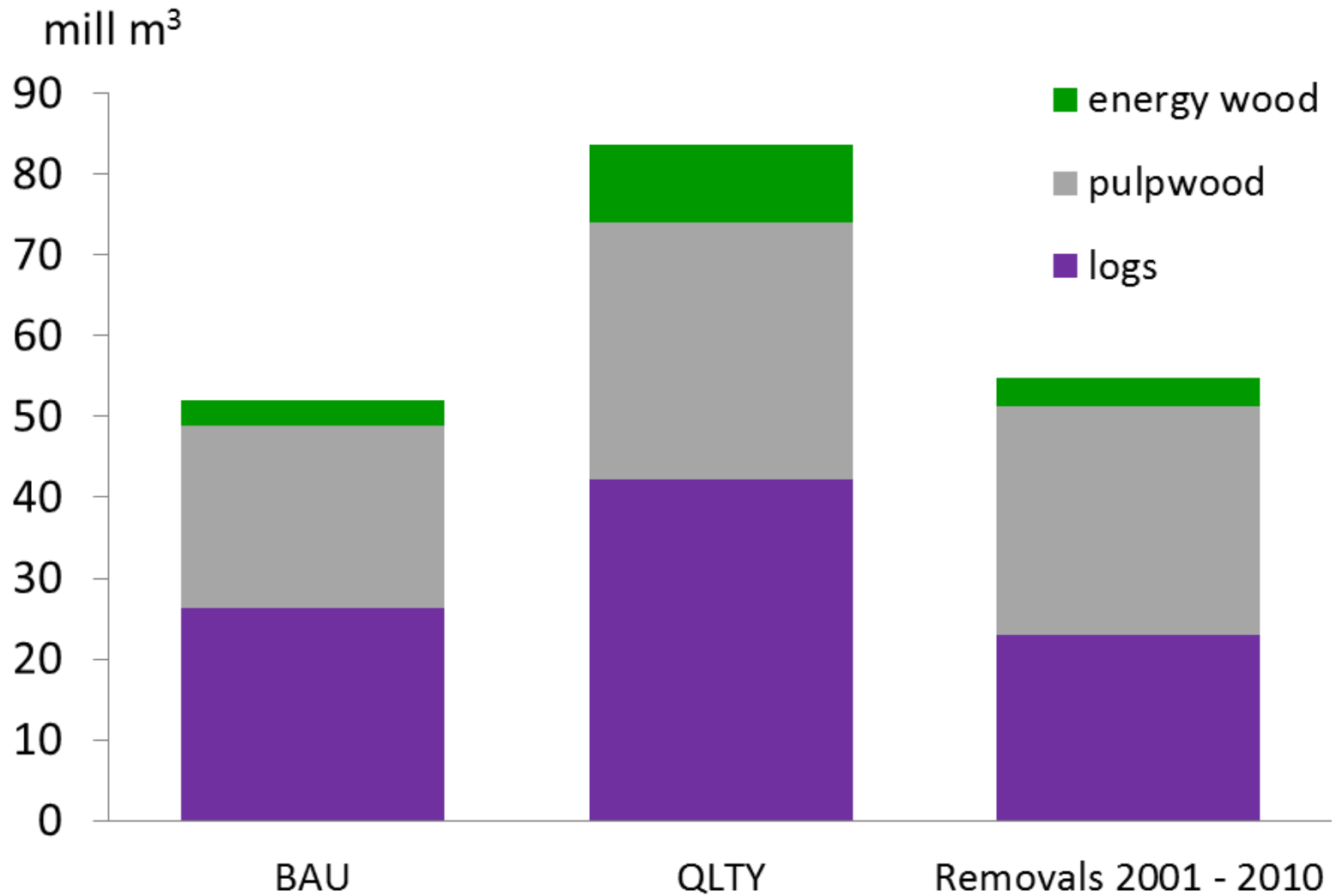
Automated simulation of alternative management regimes for each stand with MOTTI-simulator

Compiling feasible scenarios with the help of linear programming (JLP) and a priori information (forestry statistics)

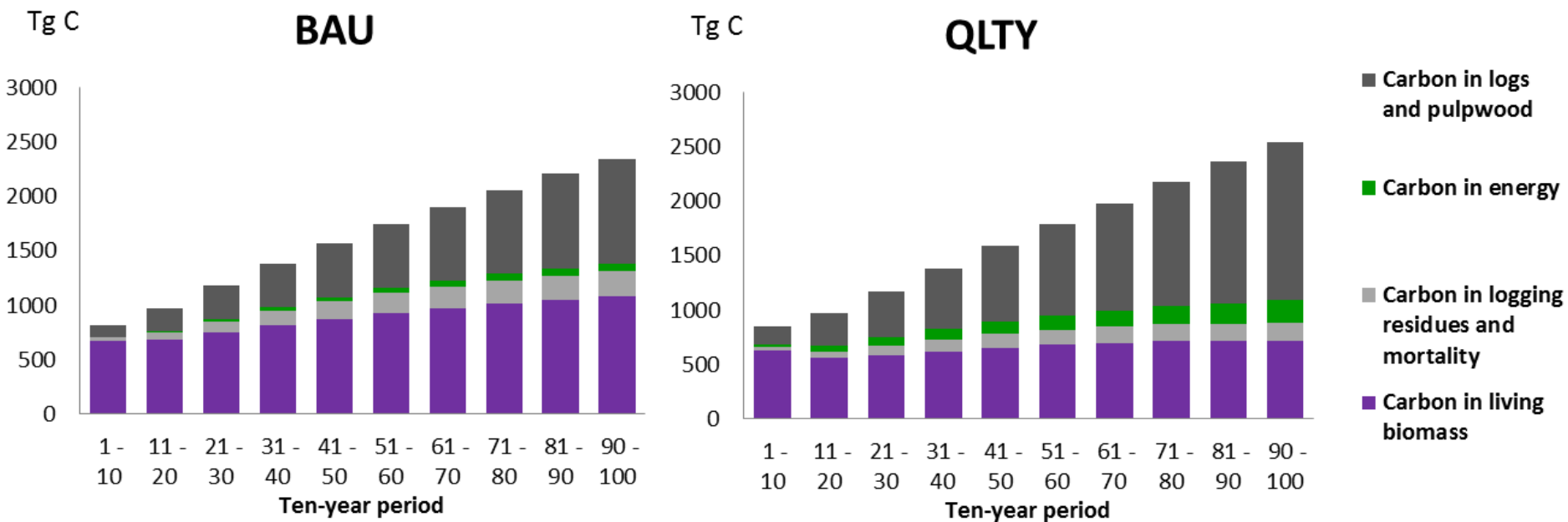
# Results

# Mean annual removals

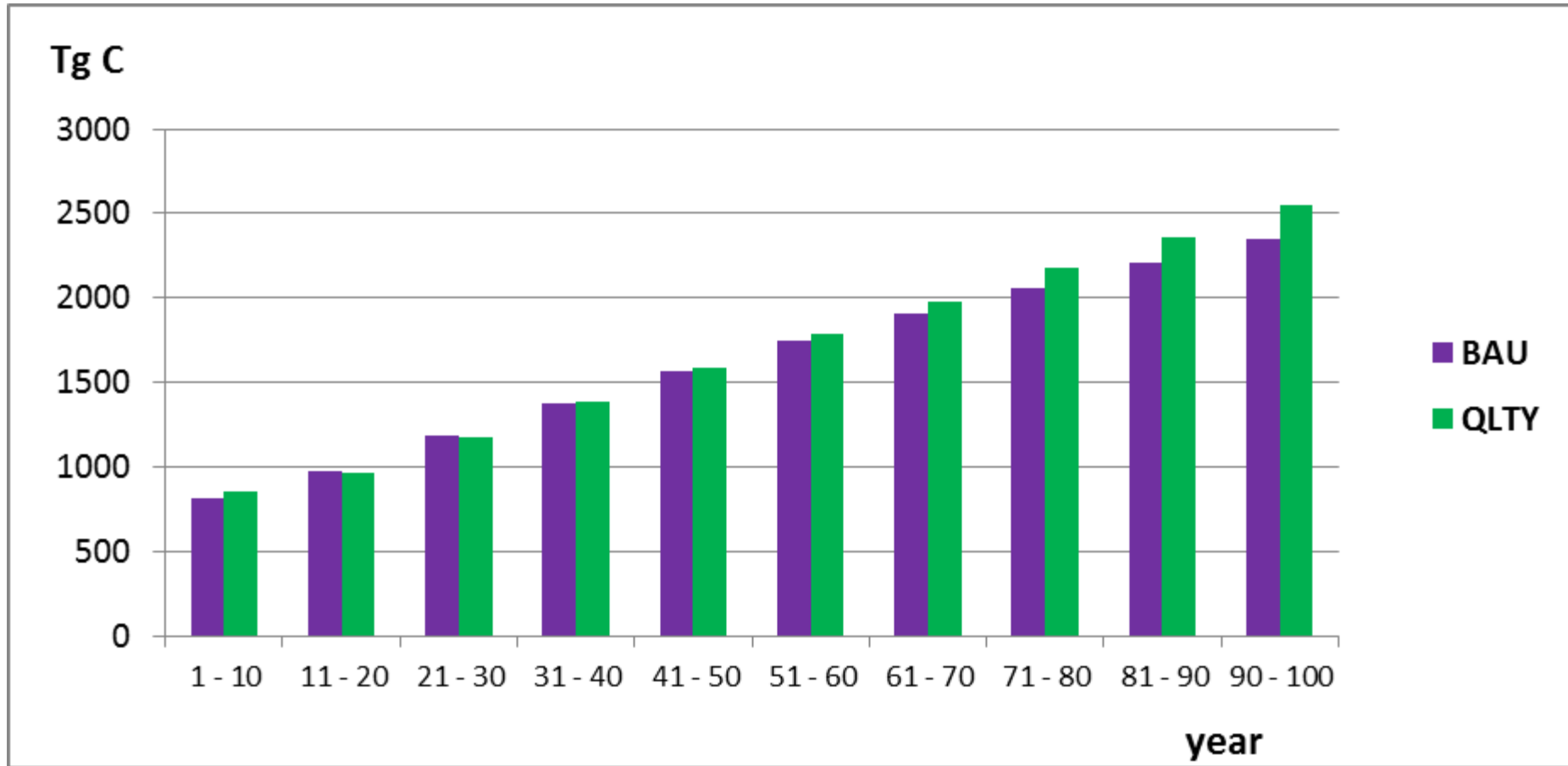
2011 - 2110



# Cumulative sequestered and recovered carbon 2011 - 20110



# Cumulative captured carbon from atmosphere, 2011 - 2110



# Conclusions (1/2)

## Results

- The analysis addresses and shows the production potential of forest resources
- It seems possible to increase annual removals without decreasing carbon storages of forests from current level by applying intensive forest management
- In the long run, intensively managed forests capture more carbon from the atmosphere than extensively managed forests
- Climate impacts depend on the use of harvested wood and biomass



# Conclusions (2/2)

## Method

- Uncertainties related to the analysis
  - impacts of changing climate are taken into account
  - changes of biotic and abiotic risks were not taken into account (no extreme disturbances)
  - development of unmanaged forests is likely to be too “optimistic”
- Analysis provides input to more sophisticated analysis on harvested wood and biomass
- It is possible to include the impacts of climate change into the prediction system of forest dynamics

# References

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*Thank you*