UNECE FOREST SECTOR OUTLOOK STUDY III:
SELECTED SCENARIOS & PRELIMINARY RESULTS

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Meeting on Exchange of Experience in FSOS and Related Work
Koli, Finland
February 14, 2019
Outline

- Introduction
- Scenario development and selection process
- Projection methods
  - Projections of global forest products markets
  - Projections of net carbon sequestration in forests and wood products
- Preliminary results
  - Reference scenarios
  - Alternative scenarios
- Conclusions

Photo: P. Nepal
Introduction

✦ UNECE FSOS III Background Report

✦ What does it contain?
  • The selected sets of reference and alternative scenarios
  • Projection methods
  • Projected forest and forest products sector outcomes for UNECE

✦ What’s the purpose?
  • Provide transparent information on the scenario selection and modelling process
  • Obtain feedback on the developed scenarios and modeling results
  • Ensure that most relevant forest sector policy debates in the UNECE are covered
  • Provide information for more detailed country-level forest sector and forest conditions projections and policy studies
UNECE/FAO ToS on FSOS and the Joint UNECE/FAO Working Party on FSEM developed a range of policy questions related to:

- Climate change mitigation & adaptation
- Structural changes in forest products demand and supply
- Green economy and sustainable development goals

<table>
<thead>
<tr>
<th>Possible scenarios</th>
<th>Average ranking (1=lowest, 3=highest)</th>
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<tbody>
<tr>
<td>Climate change mitigation</td>
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<td>Growth of specific products (construction, fibres, biorefineries)</td>
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<tr>
<td>Climate change adaptation</td>
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<td>Upcoming market scenarios (China and Africa)</td>
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<td>Trade barriers</td>
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### Scenario development/selection

#### Recommended alternative scenarios incorporating high priority questions

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13 different scenarios were selected based on 3 criteria:

- Availability of a global forest sector model that can model the majority of the recommended scenarios in an integrated way
- Existence of past studies that could answer the recommended questions without new modelling
- Availability of resources and expertise

**SSP2**
- High Forest Area (HFA)
- High Wood Cons. All (HWC All)
- High Wood Cons. Select (HWC Select)
- High Forest Area + High Wood Cons. All (HFA_HWC_All)

**SSP3**
- High Forest Area (HFA)
- High Wood Cons. All (HWC All)
- High Wood Cons. Select (HWC Select)

**SSP5**
- High Forest Area (HFA)
- High Wood Cons. All (HWC All)
- High Wood Cons. Select (HWC Select)
Scenario description: Reference

- Reference scenarios
  - The reference scenarios were directly adopted from the IPCC-inspired five shared socioeconomic pathways (SSPs)
  - SSP2, SSP3, SSP5 are included in the report
  - SSP1 & SSP4 are not included (results available)

<table>
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<th>Scenario</th>
<th>Assumption</th>
<th>Projected outcomes</th>
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| SSP2     | • “Middle-of-the-road” world vision  
• Forest products market drivers  
  • Income  
  • Total population  
  • Rural population density  
  • Labor per unit of forest area  
  • Total forest area  
  • Planted forest area | • Total and planted forest areas  
• Forest stocks  
• Wood removals  
• Prices  
• Consumption  
• Production  
• Trade  
• Forest sector carbon sequestration |
| SSP3     | • Poorer and less equal world  
• Market drivers: same as above | Same as above |
| SSP5     | • Wealthier and more equal world  
• Market drivers: same as above | Same as above |
### Scenario description: Alternative

**High Forest Area (HFA)**

- Assumes global future efforts to mitigate climate change by policy driven significant increases in total forest area (planted + natural)
- Total forest and planted forest area increase by 10% by 2040, relative to the projected area in a reference scenario in 2040

**High Wood Consumption in All Countries (HWC All)**

- Represents assumed future worldwide structural changes in wood products demand for traditional and new wood products and increased use of wood fibre in biorefineries
- Sawnwood and panel products consumption double by 2040, relative to the projected consumption of those products in a reference scenario in 2040

**High Wood Consumption in Selected Countries (HWC All)**

- Assumes doubling of demand for structural and nonstructural wood products in six countries outside of the UNECE, by 2040, relative to demands in a reference scenario
- Six most populous non-UNECE countries: Brazil, China, India, Indon., Mexico, Pakistan

**High Forest Area + High Wood Consumption in All Countries (HFA_HWC_All)**

- Evaluates whether assumed increases in forest area coupled with increased wood product consumption would achieve max. C sequestration among selected scenarios
### Scenario description: Alternative

**Recommended alternative scenarios incorporating high priority questions**

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Scenario description: Alternative

- Existing studies can help answer three policy questions:
  - Impacts of trade barriers: Buongiorno and Johnston (2018)
  - Impact of forest plantations outside UNECE: Nepal et al. (in review)
  - Carbon benefit of wood substitution: Sathre and O’Connor (2010)

- Alternative approaches are being evaluated to model the effects of climate change:
  - Developing econometric models of forest growth
    \[
    \text{forest growth} = f(\text{temperature}, \text{precipitation}, \text{CO}_2 \text{ concentration})
    \]
  - Impute the effects of climate change on forest growth, based on existing studies

- The effects of future growth of wood fibres due to expanded demand by biorefineries will be assessed qualitatively

- Effects of assumed economic “collapse” can be gauged by comparing SSP3 outcomes with SSP2 or SSP5
## Scenario development/selection

### Recommended alternative scenarios incorporating high priority questions

The potential of C sequestration in wood products due to

1. Assumed increases in wood construction in the UNECE region or globally
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17. The adoption of new and more highly restrictive trade barriers between countries and/or regions
Projection Methods: Forest Products Market

- Use of Global Forest Products Model (GFPM)
  - Widely used peer-reviewed global forest sector model, capable of modeling
    - both demand and supply of forest products
    - all UNECE subregions
    - the majority of the recommended scenarios
  - Provides market equilibrium projections of timber harvests, prices, & quantities of 14 wood products produced, consumed & traded

- Beginning year is 2014; projections are made to 2040

- Augmentation to GFPM for FSOS III modeling
  - A revised total forest area projection model, driven by income and demographic variables (rural pop. density and labor/forest area)
  - A planted forest projection model
Projection Methods: Forest sector carbon

- Carbon stored in above-and below-ground live biomass
  - Based on Johnston et al. (in press)
  - Relates to the projected changes in forest stocks
  - Based on estimated ratio of forest stocks and carbon pool data reported in the 2015 Global Forest Resource Assessment Report

- Carbon stored in harvested wood products
  - Based on Johnston et al. (in press)
  - Relates to wood products produced, consumed, and traded
  - Based on 2006 IPCC Guidelines for National GHG Inventories
  - The “production approach” is used (i.e., imported wood excluded)
Reference Scenarios: SSP2, SSP3, SSP5
Preliminary Results: Reference Scenarios

- **Key outcomes**

  - Comparing SSP2 and SSP5 against SSP3, we can conclude that wealthier and more equal worlds lead to:
    - Higher forest products consumption
    - Higher forest product prices
    - Higher roundwood removals
    - Higher production and trade of manufactured wood products
Total Forest Area—Reference Scenarios

**Total forest area - World**

- SSP2-REF
- SSP3-REF
- SSP5-REF

**Total forest area - Europe**

- SSP2-REF
- SSP3-REF
- SSP5-REF

**Total forest area - North America**

- SSP2-REF
- SSP3-REF
- SSP5-REF

**Total forest area - Russian Federation**

- SSP2-REF
- SSP3-REF
- SSP5-REF
Planted Forest Area - Reference Scenarios

Planted forest area - World

Planted forest area - Europe

Planted forest area - North America

Planted forest area - Russian Federation
Forest Stock-Reference Scenarios

Forest stock - World

- SSP2-REF
- SSP3-REF
- SSP5-REF

Forest stock - Europe

- SSP2-REF
- SSP3-REF
- SSP5-REF

Forest stock - North America

- SSP2-REF
- SSP3-REF
- SSP5-REF

Forest stock - Russian Federation

- SSP2-REF
- SSP3-REF
- SSP5-REF

UNECE
Food and Agriculture Organization of the United Nations
World Prices - Reference Scenarios
Roundwood Production—Reference Scenarios

Roundwood production - World

- SSP2-REF
- SSP3-REF
- SSP5-REF

Roundwood production - Europe

- SSP2-REF
- SSP3-REF
- SSP5-REF

Roundwood production - North America

- SSP2-REF
- SSP3-REF
- SSP5-REF

Roundwood production - Russian Federation

- SSP2-REF
- SSP3-REF
- SSP5-REF

Million m³

2015 2020 2025 2030 2035 2040

UNECE
Food and Agriculture Organization of the United Nations
Forest Biomass Carbon-Reference Scenarios

**Forest biomass carbon - World**

- **C stock (gt CO₂e)**
  - Range: -1,800 to 0
  - X-axis: 2015-20 to 2035-40

**Forest biomass carbon - Europe**

- **C stock (gt CO₂e)**
  - Range: -1,800 to 0
  - X-axis: 2015-20 to 2035-40

**Forest biomass carbon - North America**

- **C stock (gt CO₂e)**
  - Range: -300 to 0
  - X-axis: 2015-20 to 2035-40

**Forest biomass carbon - Russia Federation**

- **C stock (gt CO₂e)**
  - Range: -140 to 0
  - X-axis: 2015-20 to 2035-40

**Legend**

- SSP2, flux
- SSP3, flux
- SSP5, flux
- SSP2, stock
- SSP3, stock
- SSP5, stock
Wood Products Carbon-Reference Scenarios

**Wood products carbon - World**

- **Wood products carbon - Europe**

- **Wood products carbon - North America**

- **Wood products carbon - Russian Federation**

**UNECE**

[Logo]

**Food and Agriculture Organization of the United Nations**
Preliminary Results

Alternative Scenario: High Forest Area (HFA)
Shown for only SSP2 combination
Results: High Forest Area Scenario

- **Key outcomes (relative to SSP2 reference)**
  - Increased forest stocks
  - Increased forest biomass carbon
  - Reduced product prices
  - Increased global forest products production
  - Production increased or decreased in individual countries/regions, depending on relative changes in comparative advantages in producing products
  - Increased carbon in wood products
World Prices: High Forest Area Scenario

**Industrial roundwood world price**

![Graph showing industrial roundwood world price trends from 2015 to 2040 for SSP2-REF, SSP2-HFA, and % Change.](image)

**Sawnwood world price**

![Graph showing sawnwood world price trends from 2015 to 2040 for SSP2-REF, SSP2-HFA, and % Change.](image)

**Panel world price (average)**

![Graph showing panel world price (average) trends from 2015 to 2040 for SSP2-REF, SSP2-HFA, and % Change.](image)

**Paper world price (average)**

![Graph showing paper world price (average) trends from 2015 to 2040 for SSP2-REF, SSP2-HFA, and % Change.](image)
Production: High Forest Area Scenario
Forest Biomass Carbon: High Forest Area Scenario

### Forest biomass carbon - World

<table>
<thead>
<tr>
<th>Year</th>
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<th>2020-25</th>
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### Forest biomass carbon - Europe

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### Forest biomass carbon - Russian Federation

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Preliminary Results

Alternative Scenario: High Wood Consumption in All Countries (HWC All)
Shown for only SSP2 combination
Results: High Wood Consumption in All Countries

- **Key outcomes (relative to SSP2 reference)**
  - Reduced forest stocks
  - Reduced forest biomass carbon
  - Increased product prices
  - Increased global production and net exports, except for paper products
  - Increased carbon in wood products
    - But not enough to offset the loss in forest biomass carbon
World Prices: High Wood Consumption, All

![Graphs showing world prices for industrial roundwood, sawnwood, panel, and paper](graphs.png)
Production: High Wood Consumption, All

**Change in inst. rndwd. production**
- **Europe**
- **North America**
- **Russian Federation**

**Change in sawnwood production**
- **Europe**
- **North America**
- **Russian Federation**

**Change in panel production**
- **Europe**
- **North America**
- **Russian Federation**

**Change in paper production**
- **World**
- **Europe**
- **North America**
- **Russian Federation**
Net Export: High Wood Consumption, All

**Change in indst. rndwd. net export**
- Europe
- North America
- Russian Federation

**Change in sawnwood net export**
- Europe
- North America
- Russian Federation

**Change in panel net export**
- Europe
- North America
- Russian Federation

**Change in paper net export**
- Europe
- North America
- Russian Federation
Forest Carbon: High Wood Consumption, All
Wood Carbon: High Wood Consumption, All

Wood product carbon - World

Wood products carbon - Europe

Wood product carbon - North America

Wood products carbon - Russian Federation
Preliminary Results

Alternative scenarios

High Wood Consumption in Selected Countries (HWC Select)

High Forest Area + High Wood Consumption in All Countries (HFA_HWC_All)

Shown for only SSP2 combination
Results: *HWC Select* and *HFA_HWC_All*

- **High Wood Consumption in Selected Countries (HWC Select)**
  - Projected effects were similar to the effects observed in the *HWC All* scenario, but of lesser magnitudes
    - Reduced forest stocks, reduced forest biomass carbon
    - Increased product prices
    - Increased global production, except for paper products
    - Increased carbon in wood products
    - Not enough to offset loss in forest biomass carbon

- **High Forest Area+Wood Consumption in All Countries (HFA_HWC_All)**
  - Projected effects were similar to the effects observed in the *HFA and HWC All* scenario, but of lesser magnitudes
    - Second highest C sequestration (after HFA)
    - Price decline smaller than in HFA
    - Production slightly greater than in HWC All
Conclusions

- An attempt to show how global forest sector modelling can provide the information needed to answer important policy questions.

- Varying insights into the likely effects of future forest sector policy and market changes on forests and forest products sectors.

- These effects are mainly related to projected changes in forest products prices, and by the associated impacts on:
  - Wood removals, forest stocks
  - Production, consumption, and trade of solidwood and paper products in individual countries.

- Projections suffer from inherent uncertainties:
  - The projected trends and differences in outcomes between scenarios are still valid.
# Planned Next Steps

<table>
<thead>
<tr>
<th>Actions</th>
<th>Date</th>
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<tbody>
<tr>
<td>Your feedback today</td>
<td>14 Feb 2019</td>
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<tr>
<td>Finalizing FSOS report outline</td>
<td>15 Feb 2019</td>
</tr>
<tr>
<td>Implementation of a climate change-induced adjustment in projected forest productivity (at least as an alternative scenario, implemented in one or more SSPs)</td>
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<tr>
<td>Revised model runs based on feedback and any other adjustments warranted by the core modeling team</td>
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<tr>
<td>Writing</td>
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<tr>
<td>Complete Draft Report</td>
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<td>Review of Draft Report</td>
<td>Late 2019-Early 2020</td>
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<td>Complete Final Report</td>
<td>Early 2020</td>
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<tr>
<td>Science delivery and distribution</td>
<td>2020-2021</td>
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Thank you

Comments, questions?

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