**Note on EFSOS-II data**

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Introduction

Within the European Forest Sector Outlook Study II (EFSOS II), a suite of models have been applied to make scenario projections for the forest sector in the European countries. The most important outcomes of these projections are presented in the main report (UNECE/FAO Study Paper 28, UNECE and FAO, 2011), mostly aggregated to country groups or to the EFSOS region as a whole. Five discussion papers accompany the EFSOS II study, giving more detail about the underlying models and more detailed outcomes. However, it is impossible to present all detailed outcomes at the country level in such papers. To facilitate the use of the data and projection outcomes, a series of files have been produced and are available from the UNECE website (http://www.unece.org/index.php?id=26220). This note aims to give some more insight into how the models were linked together, and what can be found in the files on the web.

Methods

For the scenario analysis in EFSOS II, a range of models was selected to cover the whole forest sector. Selection criteria used were robustness; transparency; ability to provide analysis at the country level within Europe; being based on validated data sets; and, the ability to address the stated policy challenges. The methods used and their linkages are briefly summarised in this section, and fully presented in the references quoted, including the EFSOS II Discussion Papers.

Econometric projections of production and consumption of forest products

Projections based on econometric analysis use observed relationships between economic development and activity in the forest sector to project future activity, based on assumptions regarding future economic growth. This method was used in an earlier outlook study, ETTS V, (Baudin and Brooks, 1995) and was also applied in the previous EFSOS (UNECE/FAO Study Paper 20, UN, 2005). It provides country specific projections of consumption, production and trade of forest products. Products analysed are sawnwood, wood-based panels, paper and paperboard. At present, wood energy cannot be covered by econometric analysis due to the short historical time series available. The FAOSTAT database is the main source of historical macroeconomic data, while trade flows were obtained from the UNECE and UN COMTRADE database. Projections based on econometric analysis are only valid as far as the historically observed relationships can be expected to remain the same in the future. Hence, the method is not equipped for dealing with future trend breaks, such as the possible replacement of paper by communication methods which did not exist over most of the reference period. Making projections for longer time periods is questionable, as projections of some of the underlying variables used in the study, notably GDP, become increasingly unreliable over longer time periods, i.e., uncertainties start to dominate over pre-determined processes (Postma and Liebl, 2005). Furthermore, this projection method cannot deal internally with competition for limited resources, nor can it provide directions of future trade flows. It also requires an exogenous assumption about developments for prices and costs. EFSOS II used the price trends generated by the EFORWOOD project (Arets *et al*., 2008). Projection data can be found in the file efsos2-econometric-modelling-results-2011-09.zip.

Wood Resource Balance

The Wood Resource Balance (WRB) is a tool to map the supply and use of all woody biomass streams for a given spatial unit (country or region). The left-hand side of the balance contains all sources of woody biomass, of both primary and secondary origin. The right-hand side of the balance shows all uses of woody biomass. The WRB has four components: wood supply from forestry resources; supply of other woody biomass; material uses; and, energy uses. The WRB can be used to show the real woody biomass balance for a given year, or it can be used to show discrepancies between potential future supply and expected future demand. The WRB uses estimates generated outside the balance and is not able to indicate how a possible future discrepancy between potential supply and expected demand can be solved. More details on the WRB can be found in Mantau *et al*., 2010. Projection data can be found in the file WRB-dashboard.xls. (not yet available as of December 2011).

European Forest Information Scenario model

The European Forest Information Scenario model (EFISCEN) is a large-scale forest resource assessment model (Sallnäs, 1987; Nabuurs et al., 2003; Schelhaas et al., 2007). It applies to even-aged, managed forests. Results for uneven-aged forests, unmanaged forests and shelterwood systems are less reliable, but are included when needed to simulate the forest area available for wood supply (FAWS). EFISCEN projects the future state of the forest under assumptions of future wood demand and under a given management regime (rotation lengths, residue removals). The model is set up using aggregated forest inventory data, usually obtained from national forest inventory institutes. Age-dependent increment functions are derived from the same data, with ‘increment’ defined as a percentage of the growing stock. The soil model YASSO is built in (Liski *et al*., 2005), to give estimates of soil carbon stocks and rate of carbon sequestration. YASSO assumes equilibrium conditions, based on the litter input to the soil in the first time-step of the model. Output variables include tree species distribution; felling/increment ratio; age class distribution; growing stock level; and, carbon sequestered in biomass and soil. Recently, indicators have been developed to reflect recreational value (Edwards *et al*., 2011) and vulnerability of the forest structure to fire and wind (Schelhaas *et al*., 2010). All three indicators are based on the distribution of forest area over age classes and tree species. Recreational values range from 1 to 10, indicating increased average recreational attractiveness per ha of forest. The vulnerability indicators range from 1 to 6, indicating increased average vulnerability per ha of forest to the disturbance agents: fire and wind. EFISCEN does not provide estimates of costs for harvested wood. Projection data can be found in the efsos2-efiscen-results-2011-12.xls.

The Global Forest Sector Model

The Global Forest Sector Model (EFI-GTM) is a partial equilibrium model[[1]](#footnote-1), focusing on forest products (six wood categories, 26 forest industry products and four recycled paper grades). It makes projections of global consumption, production and trade of forest products, in response to assumed changes in external factors such as: economic growth; energy prices; trade regulations; transport costs; exchange rates; availability of forest resources; and, consumer preferences. The model covers the whole world, with a special focus on Europe. The model calculates periodical investments in production capacity of forest industry for each region. In each period, the producers are assumed to maximize their profits, while consumers are assumed to maximize their surplus. Both producers and consumers are modelled as price takers, i.e. the model assumes competitive markets, and uniform characteristics within product groups (e.g. that each m3 of sawnwood or tonne of paper is equivalent to every other m3 or tonne, a necessary simplifying assumption). Wood energy is provisionally included as a separate product in EFI-GTM for EFSOS II purposes. It is not modelled in the same way as traditional products, and is only included for EFSOS countries, so that competition between traditional wood use and wood for energy is not yet optimally included. Because of the complexity of the model, it may be difficult to identify consequences of particular assumptions needed to initialise the model, and which processes cause differences between scenarios. More details on the model can be found in Kallio *et al*. (2006). Projection data can be found in the file efsos2-efi-gtm-2011-12.xlsx.

Competitiveness analysis

Growth rates in forest product trade at the national level depend on many factors, such as the development of the world market, the commodity composition and destination of the exports, and on the competitiveness of the products on the markets. The CMS methodology analyses competitiveness in international markets, by comparing the exports of a specific country to the world exports, in different disaggregations. As a starting point, the CMS analysis assumes that the export share of a country compared to the world exports remains constant over time. The difference between the actual export growth of a country and the growth of a country under assumed constancy is attributed to a change in competitiveness. For the analysis in EFSOS II the formulation of Milana (1988) has been used. It differentiates the export growth of a country into four effects: the world growth effect; the commodity-composition effect; the market-distribution effect; and, a residual effect, which can be interpreted as the competitiveness effect.

The CMS analysis requires bilateral trade data in monetary values. The basic data for the ex-post analysis was taken from the UN Commodity Trade Statistics Database. The data for the scenario analysis, the so-called ‘future ex-post’, was derived from modelling results from EFI-GTM. Hence, scenario results of the CMS are available for the *Reference scenario* and the *Promoting wood energy* *scenario*. Outcomes of the CMS analysis are available on request.

Linkage of models

Each of the methods listed above has its specific strengths and weaknesses. The general framework for linking the models is designed to take full advantage of the strengths of the components and to limit dependency on the weaker parts. The methodological core of the EFSOS II study is the WRB. In a first step, the future development of the four different sections of the WRB were projected separately, without taking into account possible interactions between them (see WRB Dashboard.xls , not yet available). Demand for material uses was derived from the econometric analysis (efsos2-econometric-modelling-results-2011-09.zip), driven by the scenario assumptions on future GDP development. Demand for woody biomass for energy was calculated by taking existing trends and/or future policy targets into account (Steierer, 2010). The potential wood supply from the forest was derived from the EFISCEN model, using scenario-specific assumptions on availability of forest resources and management regimes (see efsos2-efiscen-results-2011-12.xls, sheet "potential supply"). The potentials for wood supply from sources outside the forest were taken from the EUwood study (Mantau *et al*., 2010). This first step gives a broad idea of whether potential available resources are sufficient to satisfy expected future demand. However, it does not indicate which resources are preferentially used, and how a possible discrepancy between expected demand and potential supply could be solved. Therefore, in the second step EFI-GTM was applied to see how possible imbalances would be ‘solved’ by the market efsos2-efi-gtm-2011-12.xlsx). Based on the projected ‘real’ demand for stemwood and harvest residues, EFISCEN projected consequences for the development of forest resources and related indicators efsos2-efiscen-results-2011-12.xls). Projected production and trade data from EFI-GTM were analysed using the competitiveness analysis to evaluate trends in competitiveness emerging from the scenarios (data available on request). Not all scenarios employ the general framework fully. Assumptions in some scenarios affect only parts of the framework, while, in some other cases, not enough resources were available to cover all parts (see also Table 1).

Scenarios

The EFSOS II main report includes a *Reference scenario* and four *Policy scenarios*. Originally, it was foreseen to have two reference scenarios, one based on the IPCC A1 SRES scenario, and one on the IPCC B2 SRES scenario. All four *Policy scenarios* would be tested against both the A1 and B2 background data. Due to resource constraints, only the B2 Reference scenario was finally presented, along with the four policy scenarios. Some models projected both the A1 and B2 scenarios. In those cases, scenarios are named as A1 Reference, A1 wood energy, etc., and their data is included in the files. If no indication is given on the SRES scenario, it is always based on the B2 background data. Minor inconsistencies between naming of the scenarios might be encountered in the different Excel files.

The four policy scenarios are *Maximising biomass carbon*; *Promoting wood energy*; *Priority to biodiversity* and *Fostering innovation and competitiveness*. The *Maximising biomass carbon scenario* explored how much more carbon could be sequestered by European forests, without reducing the annual harvest of stemwood for products and energy, and without expanding the area of forest. In the *Promoting wood energy* *scenario*, absolute priority is attached to meeting the official targets for renewable energy. The *Priority to biodiversity scenario* assumes a significant increase in area of forest protected for biodiversity conservation (6.2 million ha more than in the *Reference scenario*) and several measures intended to promote biodiversity in forests available for wood supply: no extraction at all of harvest residues or stumps, longer rotations and more mixed stands. Demand for wood (for products and energy) is assumed to remain unchanged from the *Reference scenario*, as are the non-forest components of wood supply. The *Fostering innovation and competitiveness* scenario assumes that the forest sector would become considerably more innovative than at present, under the influence of framework conditions transformed by policy measures and the attitudes of actors in the sector. This scenario is only qualitatively described and thus not projected by any of the models.

Analysis of the scenarios

The *Reference scenario* employs the full model framework, resulting in a closed balance between supply and demand, impacts on forest resources and competitiveness. The *Maximising biomass carbon scenario* uses EFISCEN to estimate the potential for increased carbon storage in forest biomass. It does not affect trade and competitiveness, since wood supply is not allowed to decrease as compared to the *Reference scenario*. In the *Priority to biodiversity scenario*, certain protection measures are applied in EFISCEN. The main outcome of this scenario is by how much the wood supply from the forest will decrease as a consequence of these measures. Impacts on trade and competitiveness are not analysed due to restricted resources. The *Promoting* *wood energy scenario* employs the full model framework, resulting in the identification of the sources of additional supply needed for wood energy, and also impacts on forest resources, and the competition between use of wood for products and energy and trade. The *Fostering innovation and competitiveness scenario* is only analysed in qualitative terms.

Table 1: Overview of methods applied in the different scenarios.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Reference | Maximising biomass carbon | Promoting wood energy | Priority to biodiversity | Fostering innovation and competitiveness |
| Potential supply from forest  | EFISCEN | Unchanged | EFISCEN | Not modelled | Qualitative |
| Supply of other woody biomass | EUwood | Unchanged | EUwood | Unchanged | Qualitative |
| Demand for products | Econometric projections | Unchanged | Unchanged | Unchanged | Qualitative |
| Demand for wood energy | Trend projection | Unchanged | Policy targets | Unchanged | Qualitative |
| Balance | WRB | Unchanged | WRB | Not modelled | Qualitative |
| Impact on trade | EFI-GTM | Not modelled, no change assumed | EFI-GTM | Not modelled | Qualitative |
| Competitiveness analysis | CMS analysis | Not modelled, no change assumed | CMS analysis | Not modelled | Qualitative |
| Impact on forest resources | EFISCEN | EFISCEN | EFISCEN | EFISCEN | Qualitative |

The *State of Europe’s Forest 2011* (SoEF 2011) has developed a method to assess sustainability of forest management, based on criteria and indicators from the FOREST EUROPE criteria and indicators of sustainable forest management. This method was also applied to the EFSOS II scenario outcomes. The details are described in Chapter 4 of the main report. The file efsos2-sustainability-analysis-2011-09.xls contains the scores for both countries and country groups, along with the values of the underlying parameters. These are derived from the different underlying projection methods.

Outcomes of all scenarios are summarised in the file efsos2-summary-2011-12.xlsx, analogous to Table 20 of the main report. It contains an overview of wood supply and demand, production and consumption of forest products, trade, and two main forest parameters (carbon in forest biomass, and forest area not available for wood supply).

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UNECE and FAO 2011 The European Forest Sector Outlook Study II 2010-2030. United Nations, New York and Geneva, 2011 (abbreviated to EFSOS II)

EFSOS Discussion papers

A series of Discussion Papers accompanies EFSOS II. These papers provide more detail on the methods and findings of the study. These will be available in electronic format at: http://www.unece.org/index.php?id=26220

Jonsson, R. (in press) Econometric Modelling and Projections of Wood Products Demand, Supply and Trade in Europe - A contribution to EFSOS II. Geneva Timber and Forest Discussion paper, ECE/TIM/DP/59. Geneva: UNECE.

Mantau, U. (in press) The Method of the Wood Resource Balance - A contribution to EFSOS II. Geneva Timber and Forest Discussion paper, ECE/TIM/DP/60. Geneva: UNECE.

Moiseyev, A., Solberg, B. and Kallio, A.M.I. (in press) Analysing the impacts on the European forest sector of increased use of wood for energy - A contribution to EFSOS II. Geneva Timber and Forest Discussion paper, ECE/TIM/DP/63. Geneva: UNECE.

Verkerk, H., Schelhaas, M.J. (in press) European forest resource development - A contribution to EFSOS II. Geneva Timber and Forest Discussion paper, ECE/TIM/DP/61. Geneva: UNECE.

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1. Partial equilibrium models equate supply and demand in one or more markets so that the markets clear at their equilibrium price levels. This makes prices endogenous. Partial equilibrium models do not include all production and consumption accounts in an economy, nor do they attempt to capture all of the economy's markets and prices. It is a useful and valid approach for sectoral analysis, in sectors, like the forest sector, which do not significantly influence general equilibrium. [↑](#footnote-ref-1)