EFORWOOD

Sustainability Impact Assessment of the Forestry - Wood Chain

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EFORWOOD

Tools for Sustainability Impact Assessment

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1 Introduction

This report belongs to the European Commission's EFORWOOD project, contract number 518128-2, which aims to provide methodologies and tools that will integrate Sustainability Impact Assessment of the whole European Forestry Wood Chain (FWC). This deliverable has been produced by Module 4, and focuses on the lessons learnt in processing and manufacturing stages of FWC in Europe. This document is a deliverable D 4.2.15 *Lessons learned in WP 4.2: Review, implication and the way forward*.

The purpose of this report is to review work carried out in Work Package (WP) 4.2 from all partners that have participated in producing deliverables. WP 4.2 links closely with WP 4.1 and 4.3. Using inputs from both these work packages WP 4.2 will act as a bridge and allow for synthesis of Sustainability Impact Assessments (SIAs) in module 4- the processing and manufacturing segment of FWCs. This report assesses the benefits, strengths and weaknesses of WP 4.2 with outlines of opportunities on how to address the later.

1.1 Process Models

Assessing sustainability is not an easy task. With no agreed method across the forest industries problems will always be encountered. There are currently a number of different tools in use across a substantial number of industries, differing even within similar sectors of the FWC. This creates great difficulty when attempting to assess and compare data.

In WP 4.2 the main objective was to review, develop or implement process models and tools within the scope of EFORWOOD for manufacturing phase of the forestry wood chain. Process tools, such as Life Cycle Assessment (LCA) tools, which are discussed and examined within WP 4.2, highlight the connection between, and the support provided by, the different work packages within EFORWOOD. Some of these tools are utilised in the data collection phase of Module 4 (WP 4.1).

Not all available process models were considered within WP 4.2 due to the large number of tools and models in existence and the quantity of data this would have produced. However, the process models that are discussed and utilised in module 4 offer core support of the ToSIA main deliverable.

1.2 Work Package 4.2 delivered reports[1]

The following reports written in WP 4.2 are included in this review:

[1] EFORWOOD project includes PD reports and D reports where

- PD (Project deliverable). An internal report not intended for the European Commission, but possible for the European Commission request.
- D (Deliverable). Reports which are required to be delivered to the European Commission.

Deliverable PD 4.2.1 ***Tool for selection of key performance indicators KPIs***
Main authors:
BRE, VTT
Date of delivery: Month 27

Deliverable D 4.2.2 ***Report on Review of Existing Tools***
Main authors:
BRE, VTT, Pöyry Forest Industry Consulting, STFI, KCL, KCPK, JPC
Date of delivery: Month 16

Deliverable PD 4.2.3 ***Report on review of technology development trends within the various processes***
Main authors:
KCL, VTT, KCPK, STFI-Packforsk, Pöyry Forest Industry Consulting, BRE, TUZVO, Cei-Bois, CEPI
Date of delivery: Month 16

Deliverable PD 4.2.4 ***Benchmarking options across the manufacturing FWC and throughout Europe***
Main authors:
VTT, BRE, Pöyry Forest Industry Consulting
Date of delivery: Month 22

Deliverable PD 4.2.5 ***Report on conditions and consequent timing of technological developments in processes relevant to case studies***
Main authors:
BRE, KCL, KCPK, VTT, Pöyry Forest Industry Consulting, TUZVO
Date of delivery: Month 30

Deliverable PD 4.2.6 ***Conceptual outline of response functions and draft response functions for case studies***
Main authors:
Pöyry Forest Industry Consulting
Date of delivery: Month 40

Deliverable PD 4.2.7 ***Report on conditions and consequent timing of technological developments in processes including the identification of country differences and obstacles to adopting changes relevant to whole Europe (elaboration of PD4.2.5 for the whole Europe)***
Main authors:
BRE, KCL, KCPK, VTT, Pöyry Forest Industry Consulting, TUZVO
Date of delivery: Month 36

Deliverable D 4.2.9 ***Technology Scenario Impacts***
Main authors:
KCPK
Date of delivery: Month 47

Deliverable D 4.2.11 ***Response factors: Background, Practical implications and their use in ToSIA***

Main authors:
BRE, KCL, KCPK, VTT, Pöyry Forest Industry Consulting, TUZVO, INNVENTIA AB (formerly STFI-Packforsk)
Date of delivery: Month 46

Deliverable PD 4.2.12 ***Sustainability Indicators for FWC; Background of approaches for reference futures***
Main authors:
BRE, KCL, KCPK, Pöyry Forest Industry Consulting, VTT
Date of delivery: Month 46

Due to changes in ToSIA, the title of Deliverable 4.2.11 was changed from 'Final report on theoretical response functions with practical implications, including ToSIA' and now represents merged objectives of the following reports originally planned in the18-months appropriate period:

- PD 4.2.8 'Draft report on theoretical response functions with practical implications'
- PD 4.2.9 'Sequel to the report on conditions and consequent timing of technological developments in processes in relationship to response functions'
- PD 4.2.13 'Response functions and reality of manufacturing processes and technologies adoption'

These changes in ToSIA also led to the deletion of Deliverable PD 4.2.10 and PD 4.2.14. After the merging and loss of several Deliverables the title of PD 4.2.12 was changed to 'Sustainability Indicators for FWC; Background of approaches for reference futures' and D 4.2.9 to 'Technology Scenario Impacts'.

2 Deliverable PD 4.2.1 *Tool for selection of key performance indicators KPIs*

The tool for selecting Key Performance Indicators (KPIs) for different process modules (e.g. existing models, developed new models, simplified models developed for ToSIA) used within M4 is described and initially tested for some process modules. The approach used in PD 4.2.1 aims to:

- Understand and define the main process alternatives in M4 and what data and parameters will affect the KPIs of different processes
- Prioritise input data parameters and calculate parameters according to their importance
- Superimpose M4 parameters on those that are required by ToSIA to establish relevant matches and divergence
- Identify appropriate modelling approaches that could be utilised in M4 and/or in ToSIA

This report's objective was to provide a composite profile of indicators for different users (e.g. manufacturers or policy makers). However, it was found that matching these would result in a severely limited list of indicators that would have to be used in EFORWOOD's outcomes such as ToSIA.

PD 4.2.1 emphasises the industrial perspective, highlighting the concept of improving sustainability in the short and long term. The principals for the selection of key performance indicators are well presented although it was acknowledged that the best way to define and measure sustainability is still contested. The main problem is the dynamic character of sustainability, without a fixed end-point that can be defined easily to a mutual agreement. Partners feel a wider array of concrete examples from different industries could have been included within the scope of the report, providing a collection of case study examples to consider in the early development of ToSIA. However, this was not possible as selection of indicators was a protracted process and insufficient consideration was given to experience from other industries.

PD 4.2.1 clearly accentuates short and long term thinking by tracing improvement options. However, the KPIs are identical across all industrial sectors creating large generalisations. They are also not dependant on a time dimension which could be a major weakness in the tools, and the selection of KPIs. The report outlined context and background on KPIs, establishing context and essential consideration in terms of policy progress within the scope of M4.

PD 4.2.1 is a short, concise report and some partners feel the basic ideas captured in the content could have been implemented in practical EFORWOOD work to a greater extent.

3 Deliverable D 4.2.2 R*eport on Review of Existing Tools*

D 4.2.2 examines the reality of FWCs sustainability appraisal tools and methodologies across all three tiers of sustainability- economic, social and environmental. It is important to note however, that D 4.2.2 does not compare the tools.

D 4.2.2 illustrates that all tools and methodologies have, undoubtedly, strengths and weaknesses depending on the objectives, timeline, and similar criteria. Depending on the requirement, it is advisable to employ more than one tool or methodology for more detailed analysis. It is one of the conclusions of D 4.2.2 that there are *'persistent national differences in the need for sustainability assessment, linked to national requirements of relevant legislation and regulations'*.

One of the main issues highlighted by D 4.2.2 is the distinct lack of any accepted and widely used tools that assess the social side of the manufacturing business across FWC streams (e.g. pulp and paper, wood based products, biomass). In qualitative terms the social tier of sustainability remains an extremely difficult area to assess. Although focused research was undertaken into tools for assessing sustainability, no tools or methodologies used in Europe for the social tier in FWC, relevant to manufacturing stages which is the focus of Module 4, were found. The FWC is the only industrial sector that has already been under scrutiny to address social issues in the forestry phase however, the core difficulty with social indicators is that they are qualitative in their nature as previously mentioned. Respective sets of data from individual industries means they are not comparable and there does not appear to be an agreed upon and widely used set of criteria, and therefore widely accepted tools, across all industries. There is a great deal of confusion understanding social issues and this uncertainty makes '*development of a comprehensive set of agreed methodologies, indicators and tools for addressing social issues of sustainability especially difficult*'. From the research undertaken in the international context it is apparent that greater assistance in understanding which sector-relevant social issues are appropriate is undeniably needed both with the FWC and other industries.

The explicit descriptions of partner tools give a solid background for future users of ToSIA, documenting methods of data calculation. Partners discussed the possibility of considering non-partner tools within the scope of the project, and introducing GRI (Global Reporting Initiative) indicators within the tools section. This could have lead to the identification of new co-operation partners. However, due to the vast number of specific tools worldwide handling the infinite volume of information and ensuring that all possible tools were investigated would have proved a significant challenge.

For EFORWOOD partners D 4.2.2 is extremely useful, highlighting and introducing tools some partner may have been unaware of. The work with sustainability indicators is based on the expertise of the partners and this expertise originates from the use of different tools presented in this report.

Overall D 4.2.2 provides a high-quality overview of widely applied tools relevant to use in FWC and specific information on tools used in this project. It provides

information to assist in the understanding of the industrial viewpoints in EFORWOOD. Comparison of the tools and their usability to provide data for ToSIA were not aims of this deliverable but would have been beneficial to the project. However, the data needs for ToSIA were continuously changing throughout the project and this meant that such analysis would have been challenging and resource over-intensive.

4 Deliverable PD 4.2.3 *Report on review of technology development trends within the various processes*

PD 4.2.3 is a review of existing new, developing and upcoming technologies and trends in the forest sector. The technologies listed in this deliverable have a significant positive impact on economic, environmental, social, and/or quality aspects of FWCs. They focus on three main impact areas:

- Improved product properties
- Environmentally friendly processes/products
- Increased profit

PD 4.2.3 is an informative deliverable providing insight to future technologies which could potentially significantly contribute to improving levels of performance from sustainability point of view. The report included a wide overview of development trends and possible technology changes in all M4 areas: bioenergy, solid wood processes and the pulp and paper chain.

The technologies discussed are included in EFORWOOD as a background report but not currently within ToSIA itself. The report formed part of the foundations for estimating the indicator values of Module 4 processes for the reference futures[2]. ToSIA does not consider these technologies directly but the indicator values of reference futures and scenarios are partly based on assumptions from this report. Partners discussed the potential inclusion of the new technologies discussed in PD 4.2.3 within ToSIA. These new technologies could replace the older processes as the new technologies become more prevalent across Europe, in order to see the changing results.

One weakness of PD 4.2.3 could be seen as the varying contributions from partners. Some technologies chosen had already been widely tested or were already in use in some countries or regions, while others were potential ideas or case-specific options. Pulp and paper technologies were focused more so on development trends and the possibilities in how to reach them, while solid wood and bioenergy examples focused more on specific technologies and their effects. These case specific technologies could prove difficult to apply to the industry on a global level, even in the future. Therefore, these technology development trends could not realistically be included to much extent in EFORWOOD due to their lack of influence on FWC at the general level.

The technologies incorporated in PD 4.2.3 do not exclusively include all technologies currently in use in the forest industry, only those in which EFORWOOD partners have specific knowledge. PD 4.2.3 presents them in order to provide instructions and ideas for future studies and possibilities. Future work in EFORWOOD may also include other technologies outside this deliverable. As noted in PD 4.2.3 *'as far as ToSIA is concerned, it is important that this deliverable is checked regularly, e.g. every two years, in order to remain at the forefront of changes in technology situations within the forest industry'*.

[2] For further information concerning reference futures, please see www.eforwood.org

5 Deliverable PD 4.2.4 *Benchmarking options across the manufacturing FWC and throughout Europe*

PD 4.2.4 examines benchmarking options for companies and regions, at a national and European level, across the manufacturing FWC and throughout Europe. The general benchmarking theory is described and a number of case studies present different types of benchmarking cases, illustrating the variety of possibilities in environmental benchmarking.

Even though any measure of sustainability will have shortcomings given the significant gaps in critical data sets and divergent views concerning what comprises sustainability, this document provides a valuable summary measure for sustainability performance within the scope of EFORWOOD.

While absolute measures of sustainability remain elusive, many aspects can be measured at least in relative terms. This report outlines that need for a quantitative and systematic approach to sustainability policymaking which:

- tracks problems through a carefully constructed set of metrics and indicators
- illustrates benchmarking of results from sustainability assessments against a relevant peer group

Conclusions are that the above approach would help to highlight superior environmental, social and economic programmes, technologies and approaches of sustainability on a par.

The information in the report is essential for the future work on response functions in work packages 4.2 and 4.3. In addition, it highlights the fact that the need of tailor making in environmental comparisons and benchmarking should be kept in mind in M1 and the development and interpretation of ToSIA

The main benefit of PD 4.2.4 is that of providing essential background information for ToSIA development in terms of incorporating further benchmarking in the tool. It also provides stand-alone information for ToSIA users, enlightening some of the issues associated with benchmarking and modelling and making users aware of the concept. This background information and knowledge can also enable easier comparison between different chains within ToSIA.

6 Deliverable PD 4.2.5 *Report on conditions and consequent timing of technological developments in processes relevant to case studies*

PD 4.2.5 is a follow up on deliverable 4.2.3 with focus shift from general development trends to technology specific trends and implications. PD 4.2.5 considers numerous technologies from the pulp and paper and recycled paper industries, plywood sawmills, panel board and joinery industries and bio energy. The report contributed to the analysis of the impact of technology development trends on module specific models. PD 4.2.5 also identifies the conditions for, and timing of, implementation of the technological changes and development of response functions. Changes within the different industries are summarised as falling into the three categories, autonomous trends, foreseen major changes and 'radical change'. The expected rate of introduction within the industry is also discussed.

PD 4.2.5 provides a useful background to the technologies and gives a valuable estimate to the timing of each technology adoption. An initial aim of PD 4.2.5 was to aid WP 4.1 (data collectors) in estimating data for reference futures by providing an indication of the improved technologies available at these times. Particular technologies and sections of the report proved to be more useful than others and it is these technologies and which were carried forward to be included in the sequel report, PD 4.2.7. The sawmill industry technologies are an example of the useful technologies included in PD 4.2.5 as they provide a beneficial component towards the technology scenario. The report brings the content of PD 4.2.3 closer to the ToSIA approach however its effectiveness was hampered by the need for data quickly and it is not implemented as such in ToSIA.

The main benefit of PD 4.2.5 is the high-quality overview of upcoming technologies which have been recently developed or are in the stage of being developed in relation to primary production processes. The report provides clear tables indicating how the adoption of the technologies is estimated to occur over the next 20 years providing some assistance in the formulation of future indicator and scenario data.

The main limitation of PD 4.2.5 is the uncertainty of estimations made regarding the technology adoption. The estimations are expert guesses and therefore are not guaranteed to be either reliable or accurate. The further into the future the estimations are made, the greater the degree of uncertainties that will occur. Predicting 20 years into the future is complex, even for experts of the fields. It could also be considered that PD 4.2.5 was not utilised to its full potential as the results found were subjective and the implication of the estimation were unable to be quantified. Unfortunately, another limitation of PD 4.2.5 was the lack of data provided for the furniture industry.

7 Deliverable PD 4.2.6 *Conceptual outline of response functions and draft response functions for case studies*

In PD 4.2.6 the theory of response functions is described and typical prioritisation and screening methods are presented. The report demonstrates the use of these methods in Module 4 and provides draft response functions for the case studies.

PD 4.2.6 could be regarded more a theoretical than practical report. Its preliminary purpose is to present information to Module 4 and other EFORWOOD partners concerning the nature and use of response functions and illustrate at a very 'hands-on' level how they were applied within Module 4.

Partners view the use of response functions to be a useful tool in the development of ToSIA, in their original definitions, and a main benefit of PD 4.2.6. Although extremely hard to define, the use of response functions would open up possibilities to create an increasingly dynamic model. Users could formulate runs involving parameters which could be altered continuously, e.g. oil price development, instead of static time points in which all parameters are fixed. However, implementing response functions is a challenging task. Variables impact not only upon indicators but also other variables. Due to these cross impacts, consequences of the changes in the variables, need to be kept rather simplified. In addition to its usefulness for ToSIA, PD 4.2.6 illuminates the concept of response functions and provides excellent insight into the theory and methods of designing response functions as well as practical examples of implication.

However, the subject of response functions can be highly complex and can lead to confusion in some areas. At the time of compiling the report there were no finished decisions on the role of response functions as a part of ToSIA and this lead to insufficient coverage of this topic. This in turn can be considered to be the weakness of PD 4.2.6. Unfortunately, due to alterations in the development of ToSIA response functions were not uniformly implemented across all modules and could not, therefore, be utilised to their maximum potential.

8 Deliverable PD 4.2.7 *Report on conditions and consequent timing of technological developments in processes including the identification of country differences and obstacles to adopting changes relevant to whole Europe (elaboration of PD 4.2.5 for the whole Europe)*

PD 4.2.7 is an elaboration of PD 4.2.5 therefore keeps the general background to the technologies as provided in its predecessor (PD 4.2.5). The report updates relevant technologies and identifies technologies which have been superseded and are no longer relevant for EFORWOOD. In addition to this PD 4.2.7 expands on PD 4.2.5 in aiding the development of scenarios for the reference futures. PD 4.2.7 includes the structure and core information from PD 4.2.5, with the focus and add-on of the report being the regional variation of each technology. The conditions the adoption of the technology is dependant on and the discussion of obstacles facing each technology are also included.
A series of tables is used to identify:

- Stages of adoption for each technology is currently at in the different regions of Europe
- Estimates of uptake of the technology up to the year 2025
- Reasons for regional implementation differences
- Obstacles to and conditions which the adoption of this technology is dependent on
- Advantages and disadvantages of the adoption of the technology

As this report is an elaboration of PD 4.2.5 many of the benefits and limitations of the report remain the same. PD 4.2.7 (along with both PD 4.2.3 and PD 4.2.5) provides a good general background of the latest upcoming technologies and invokes catalysing thinking concerning the future of forest industries. Due to these factors it therefore assists the delivery of data collection in the reference futures although, as mentioned with PD 4.2.5, its utilisation for this purpose was hampered by the immediate need of data. Just as PD 4.2.5 brought its predecessor closer to the ToSIA approach, PD 4.2.7 also achieves this by analysing the obstacles and identifying the conditions of each technology adoption. It is also felt among the partners to have improved the presentation of PD 4.2.5 and due to standardised sections, the technologies from different FWC streams can be compared. The tables displaying the regional differences between the adoption of each technology is also considered to be a positive of the report according to the partners.

The main limitation of this report (as with PD 4.2.5) is the uncertainty of the estimations made regarding technology adoption. The estimations are expert guesses and therefore are not guaranteed to be either reliable or accurate. The further into the future the estimation are made for the greater the degree of uncertainties that will occur. Another disappointment of this report; as previously mentioned in its predecessors, was the lack of information from the furniture industry. Legislation issues were also discussed as areas of potential further research as this seems to be an obstacle faced by many of the technologies. As with PD 4.2.5, it could also be

considered that PD 4.2.7 was not utilised to its full potential as the results found lacked agreed principles of objectivity and the implication of the estimation were unable to be quantified.

9 Deliverable PD 4.2.9 *Technology Scenario Impacts*

The technology scenario is implemented in the Scandinavian Case. The scenario is comprised of a set of new technologies in the wood products value chain that increases the efficiency of materials and/or increases the quality of the end products. This includes the increased production of value added wood components and the upgrading of sawn timber.

PD 4.2.9 provides a clear, extensive scenario description and an overview of quantitative scenario impacts on economic indicators (EFI-GTM runs), which was useful in the data collection stages. It also incorporates an overview of impacts from two levels of the scenario on several key drivers of the FWC. Without PD 4.2.9 calculating scenario data would have proved difficult. The Scandinavian case study is the only scenario to consider and include technological changes and is therefore a valuable case for ToSIA development and analysis.

EFI-GTM provided a uniform approach throughout the Scandinavian case study (and EFORWOOD) and was therefore an acceptable solution in predicting impacts within the scenario case study. However, it has also been discussed that EFI-GTM is ideally suited to modelling trade flows rather than modelling impacts at the technology level. It would be a difficult task to evaluate the quantitative EFI-GTM results based on PD 4.2.9 as the structure or methods used behind the results produced by EFI-GTM are not discussed or analysed. However, this is an over arching issue in EFORWOOD, not specific to PD 4.2.9.

Overall PD 4.2.9 provides high-quality guidance concerning data collection for the technology scenario. It is a well documented overview of the steps taken in developing the scenario and of scenario assumptions. However, EFI-GTM run data may not be representative at the level of individual technologies. Although PD 4.2.9 was helpful in providing input for scenario data collection, ideally the overall impact of the scenario (based on the results of ToSIA) would have been reported in this PD. Unfortunately this was not possible as ToSIA was not analysing scenario data at the time of PD 4.2.9's completion

10 Deliverable D 4.2.11 *Response factors: Background, Practical Implications and their use in ToSIA*

The aim of D 4.2.11 is to provide background information on response functions and present examples indicating how they can be used to estimate changes in sustainability impact assessment. Additionally, it also illustrates how these changes are likely to be implicated in the real world. D 4.2.11 describes how response factors have developed and how they are to be used in EFORWOOD, reasoning their usefulness and relevance to ToSIA. A number of case studies are discussed in which response factors, and other methods, have been used to estimate environmental, economic and social changes for the reference futures.

D 4.2.11 was not an originally included in the work of WP 4.2. However partners felt it was required in order to demonstrate the need for response functions, despite ToSIA's reliance on other methods of evaluating reference futures such as EFI-GTM runs.

D 4.2.11 also discussed the reasoning behind the change of name from response functions to response factors. One of the objectives of this report was to demonstrate that response factors are still an appropriate method of calculating indicator values, discussing accuracy and reliability. However, this is highly dependant on the quality of the response factors. As can be seen in the discussion of this report, response factors are subject to induced errors which can lead to increased errors if the factors are not highly accurate.

As historic trends form the basis of response factor formulation partners within Module 4 believe they are robust method of providing reliable estimations for reference futures given the current knowledge available. Despite this there are many threats to the quality of the response factors, as indicated in D 4.2.11. Response factors contain a number of assumptions and suffer from inconsistency between modules, and in some cases between the different sectors e.g. Pulp & Paper, Solid wood and Bioenergy. It is also extremely difficult for response factors to consider major changes such as new technologies, technologies which have been described in previous reports (PD 4.2.5 and PD 4.2.7). These reports suggest that a number of new technologies will have been implemented within the time frame of the reference futures therefore could drastically affect the response factors. This is a major weakness of EFORWOOD highlighted by D 4.2.11, the issue that any future prediction is unable to avoid inaccuracies, especially when taking new developments into consideration.

One of the key benefits of D 4.2.11 is the detailed explanation of the generation of response factors through to their use in estimating indicator values in the reference futures. It also elucidates M4's specific approach to response factors and the practical implications of the quantitative results produced. This information is extremely valuable and can aid in the interpretation of ToSIA results. D 4.2.11 also provides a thorough conclusion highlighting that response factors are still extremely useful but indicating the limitations of estimating future values via this method.

Indicator specific descriptions were provided for social indicators and D 4.2.11 could have been further developed by expanding these specific descriptions to also include environmental and economic indicators. Descriptions of the quality of the response factors used and their possible improvement could also have been included within the scope of the report. As response factors were not implemented for social or economic data it may have been appropriate to exclude this data from D 4.2.11, focusing solely on environmental data which did use response factors to estimate future indicator values. This would have created a concise report and may have led to an increasingly detailed analysis of the results however, the report content would have been somewhat repetitive.

11 Deliverable PD 4.2.12 *Sustainability Indicators for FWC; Background of approaches for reference futures*

PD 4.2.12 provides background information concerning the interpretation of the reference futures indicator values. The document presents a step by step approach to Module 4 work on response factors and is thus extremely important background information for interpreting ToSIA results. The main issues addressed are calculations and methodologies applied and the advantages and disadvantages of some of the approaches considered and used.

One of the major issues highlighted by PD 4.2.12 is that of data accuracy within the reference futures. Finding high quality statistics at the European level is, and will be, a problem in large scale projects such as EFORWOOD. If the 2005 base data sets for indicators are of low quality (i.e. estimations rather than high quality data) then this will influence the representativeness of future scenarios. As stated in PD 4.2.12 *'this is an inevitable result of this initial scoping study type project providing mapping of availability and quality of data obtainable on a public access basis'*. Raising this issue in the paper also indicates that this is an area of research that could indeed be investigated further. Providing reliable data would greatly improve the outcome of EFORWOOD and ToSIA results allowing far greater and considerably more reliable conclusions to be drawn.

Another benefit of PD 4.2.15 is that of drawing attention to the lack of consideration within the reference futures of short term or sudden changes in real-time dimension. This subject again highlights the importance of reviewing results whilst constantly considering the assumptions which were taken to avoid any abnormal conclusions in terms of future data sets.

A number of different approaches were used when considering the reference future data. Due to the fact that there was not an agreed framework to employ one particular approach within the EFORWOOD project partners in Module 4 were able to define, what they felt, the most suitable approach to the reference future calculations. For example in Module 4, reference factors were used for calculating environmental indicators but EFI-GTM runs were utilised for employment figures. This could then lead to difficulties if these choices were not consistent across all sectors and modules. Although all future scenarios results are valid and justifiable in terms of appropriate assumptions and descriptions, due to the different approaches implemented they are not comparable across the indicators. Assumptions behind the EFI-GTM data are also not provided. The assumptions made in the EFI-GTM runs are thus transferred into our datasets in reference futures and scenarios without providing a true explanation or description.

12 The Way Forward

The aim of EFORWOOD is to provide methodologies and tools that will, for the first time, integrate Sustainability Impact Assessment of the whole European Forestry-Wood Chain (FWC), by quantifying performance of the FWC. Several areas have been noted throughout the progression of Work Package 4.2, into which further research and work could be carried out. This further work could continue with the development of EFORWOOD and Sustainability Impact Assessment within the forest industries.

PD 4.2.2 was the first deliverable completed in WP 4.2 and highlighted that from the research undertaken in the international context it appears that more assistance is undeniably needed, both with the FWC and other industries, in understanding which sector-relevant social issues are appropriate in terms of addressing social issues of sustainability. Within the manufacturing stage of the FWC there were no tools or methodologies identified for assessing the social tier. This highlights an area in which a great deal of research is still required. Development of such social sector tools and methodologies would significantly benefit ToSIA and any future projects involving assessing sustainability within the social sector.

As mentioned in PD 4.2.3 the main technologies that have been reviewed and discussed in WP 4.2 are those in which EFORWOOD partners have specific knowledge. Future work could include technologies outside of this deliverable, utilising skills and knowledge from across the forest industries. PD 4.2.3 also states that it is vital the deliverable is updated regularly in order to remain at the forefront of changes in technology situations within the forest industry.

One of the other disappointments within Module 4, as mentioned in PD 4.2.5 and PD 4.2.7, was the lack of information from the furniture industry. Further research within all three tiers of sustainability appear to be needed in the furniture industry. Legislation issues seem to be an obstacle faced by many of the newer technologies, as mentioned in PD 4.2.7, emphasising this as an area which could be researched in further detail.

PD 4.2.11 and PD 4.2.12 both raised the issue of data accuracy within the reference futures. As with any large scale project, obtaining high quality statistics was an area of great difficulty within EFORWOOD. Any inaccuracies in the base year data can lead to far greater inaccuracies in the future scenarios. Gathering base year data with minimal errors is an enormous task for such extensive projects and an area of research which could be investigated much further.

Overall there are a number of issues highlighted within Work Package 4.2 which could continue to be researched and developed. This further work could dramatically improve the tools and methodologies that integrate Sustainability Impact Assessment across the whole European Forestry-Wood Chain and aid in developments across the forest industries in all three tiers of sustainability.