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Subsector Analysis: Vietnam

Sustainable Feedstock Supply through Certification of
Wood Substrates for Biomass Combined Heat and
Power (CHP) Systems in Vietnam



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Currency

1 USD =	21,000 VND (April 2016)
1 EUR =	25,000 VND (April 2016)

Measurement

W	Watt	Wh	Watt hour	1 ha	1 Hectare
kW	Kilowatt	kWh	Kilowatt hour	1 M ha	1 million hectares
MW	Megawatt	MWh	Megawatt hour	1 M m ³	1 million cubic meters
GW	Gigawatt	GWh	Gigawatt hour		

List of Acronyms

ACT	Avoided Cost Tariff
ASI	Accreditation Services International GmbH
BMEL	Federal Ministry of Food and Agriculture (Germany)
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Germany)
BMWi	Federal Ministry for Economic Affairs and Energy (Germany)
BLE	Federal Office for Agriculture and Food (Germany)
BPPD	Biomass Power Development Plan (Vietnam)
BWaldG	German Federal Forest Act
CHP	Combined Heat and Power
CoC	Chain of Custody
CW	Controlled Wood
DEG	Deutsche Investitions- und Entwicklungsgesellschaft mbH
EC	European Commission
EU	European Union
EUR	Euro
FLEGT	Forest Law Enforcement, Governance and Trade
FM	Forest Management
FMU	Forest Management Unit
FSC	Forest Stewardship Council
GFTN	The Global Forest & Trade Network
GGL	Green Gold Label
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HAWA	Handicraft & Wood Industry Association of Ho Chi Minh City
HCVF	High conservation value forests
IGI	International Generic Indicators (FSC)
ILUC	Indirect land use change

ISCC	International Sustainability & Carbon Certification
ITTO	International Tropical Timber Organization
LD	Legality Definition
MARD	Ministry of Agriculture and Rural Development (Vietnam)
MoIT	Ministry of Industry and Trade (Vietnam)
MTCC	Malaysian Timber Certification Council
NTFP	Non-Timber Forest Products
PEFC	Programme for the Endorsement of Forest Certification schemes (formerly Pan-European Forest Certification)
PDP	Project Development Programme
PDP VII	National Power Development Master Plan No. 7 (Vietnam)
RE	Renewable Energies
RWE	Round Wood Equivalent
RSB	Roundtable on Sustainable Biomaterials
SBP	Sustainable Biomass Partnership
SFM	Sustainable Forest Management
SLIMF	Small and/or Low Intensity Managed Forest
TLAS	Timber Legality Assurance System
USD	United States Dollar
VFCS	Vietnam Forest Certification Scheme
VND	Vietnamese Dong
VPA	Voluntary Partnership Agreement
WWF	World Wide Fund for Nature (formerly World Wildlife Fund)

Executive summary

Associated with the rapid expansion of the utilization of biomass as a renewable source of energy and an effective way to mitigate climate change, sustainability issues are gaining increasing importance. As a result, sustainability certification of biomass for energy purposes is gaining importance to mitigate risks and negative side effects. Directed at German companies who plan to engage in the Vietnamese bioenergy sector, this subsector analysis aims to provide guidance to analyze risks along the supply chain, to assess which certification scheme best addresses those risks, and to get a first understanding of both the costs and benefits of sustainability certification. Solid biomass in this analysis refers exclusively to feedstock from wood and wood residues recovered from natural forests and plantations as well wood processing industries. Other substrates such as rice straw and rice husks are not covered.

Potential impacts from using woody biomass for energy purposes are multidimensional and affect the social, the economic as well as the environmental settings. Feedstock supply and bioenergy generation not only supports the regional economy through job creation and income generation but also increases independence from energy imports, contributes to climate change mitigation when fossil fuels are replaced by biomass and the establishment of forest land by afforestation and reforestation. In contrast, unsustainable production of woody feedstock may lead to the conversion of natural forests to plantations, as well as the uncontrolled expansion of plantations and therefore to a loss of biodiversity, soil degradation and water erosion.

In the Vietnamese context, bioenergy from wood can contribute to the country's energy mix and climate targets by increasing the share of renewable energy and simultaneously reducing the dependence on fossil fuels. Wood fuel based combined heat and power (CHP) systems may provide an attractive alternative to conventional energy solutions. Besides wood material from plantations or landscaping, the residues of the extensive Vietnamese woodworking industry offer a nearly untapped potential for the feedstock supply but potential negative environmental and social impacts have to be considered.

Sustainability risks of woody biomass produced in the European Union (EU) are comparatively low owing to the existing legal framework in the agriculture and forest management. Up to now there is no mandatory, EU wide regulation concerning sustainability of *solid* and gaseous biomass for energy purposes. Sustainability is being addressed by various voluntary as well as mandatory certification systems and regulations mainly at national level which often lack compatibility with each other. The European Commission is likely to include sustainable biomass policies and legislation in a new Renewable Energy Package in 2016/ 2017. Independent from the energy use, forest biomass and related legality risks are regulated by the EU Timber Regulation (Regulation (EU) No 995/2010) and the new EU Forest Strategy with ambitious target that all EU forests are managed according to the principle of sustainable forest management (SFM). Some EU member states introduced sustainability regulations for solid biomass focusing on avoided green house gas (GHG) emissions and/or energy input along the whole supply chain, on traceability and origin of the feedstock as well as on sustainable forest management practices. In Germany targets and measures for the bioenergy and biomass development are defined by various action plans including the national action plan for biomass, the action plan for renewable energy and the energy concept for an ecofriendly, reliable, and affordable energy supply. As result of the action plan and the energy concept two *mandatory* sustainability regulations entered into force in 2010 which implement the sustainability aspects of the European Renewable Energy Directive at the national level (BLE 2014), the Biomass Electricity Sustainability Regulation and the Biofuel Sustainability Regulation. So far in Germany there is no binding national legislation on sustainability of solid biomass. National laws like the Federal Forest Act (BWaldG), the Federal Nature Conservation Act, and the Plant Protection Act, combined with provincial laws regulate the production of solid biomass for energy within Germany. In addition, voluntary certification schemes for SFM are prevalent in Germany. Out of the total forest area of almost 11 M ha, more than 71.69% are certified, mainly by the standard of the Programme for the Endorsement of Forest Certification schemes (PEFC) but also by the Forest Stewardship Council (FSC) standard (BASIS n.d.). Regarding sustainable feedstock supply from outside Germany and Europe, two initiatives namely the “qualiS” and the “HackZert” cooperate to develop a consistent standard for wood chips at national level, which however, mainly focus on the quality dimension and not explicitly on the sustainable origin of the feedstock.

In the context of the utilization of woody biomass as feedstock for CHP conversion, Chapter 2 briefly describes the underlying framework conditions and legal requirements regarding the development of forestry and bioenergy in Vietnam. Sustainable forest management and the expansion of renewable energy are key areas of development and directly support the national development targets as set forth by the National Socio-Economic Development Strategy (SEDS) 2011-2020 and the National Green Growth Strategy (NGGS) 2011-2020 with a vision to 2050.

From 1990 to the present, the forest area has been increased gradually, mainly due to afforestation and rehabilitation of natural forest as well as the large increase of production (plantation) forest. By the end of 2013 around 42% of the total land area or 14 M ha were covered by forest of which 9-10 M ha or about 75 % was natural forest and 3.5-4.0 M ha or 25.5% plantation forest. The rapid increase of forest area can mainly be attributed to the setting of a comprehensive legal framework with numerous supporting policies for its implementation, directed towards conservation of natural forest, the economic use of converted or newly planted forest for timber, woodchip and fiber as well as change of ownership rights from state forest enterprises (SFE) to an increased private sector involvement, including small holder and communities. The total amount of timber harvested from domestic natural forests and plantations in 2013 totaled approx. 17 M m³ RWE (Round Wood Equivalent). Of that amount, 12 M m³ or 70% was processed to wood chips, mainly produced for export (ViFores 2013). The remaining 5 M m³ or 30% was used for the production of medium-density fiberboard (MDF) and plywood production, pulp and paper and carpentry. At the same, about 4 M m³ RWE or 30 % of the total wood processed was imported mainly for furniture production. Total export turnover of timber products in 2014 was around 6.3 billion USD whereas the import of timber material (mainly round-wood and sawn wood) amounted to about 2.5 billion USD. Wood chip exports during 2012 – 2014 ranged between 6-7 M dry tons/year resulting in an annual export value of 800 to 950 M USD. The strong demand for wood chips is to a large extent driven by the expansion of renewable energy using wood chips as a fuel source for bioenergy.

Vietnam's forestry sector is governed by the Forest Protection and Development Law (No. 29/2004/QH11) promulgated in December 2004 and divides forestland into three categories (VNForest 2013), (1) protection forest, (2) special use forest and (3) production forest.

The Vietnam Forestry Development Strategy 2006-2020, promulgated in February 2007, sets out the key strategies for the development of the forest sector until to date guided by the Forest Protection and Development Plan for the period 2011-2020. Key measures, guiding the implementation of the plan include the following policies:

- Logging ban on natural forest to restrict the illegal timber exploitation to properly protect the existing area of natural forest.
- Increase the forest area from currently 14 M ha to around 16.2–16.5 M ha in 2020, composed of 8.1 M ha production forest, 5.8 M ha protection forest and 2.2 M ha special use forest.
- Improve the quality of natural forests to ensure commercial timber proportion of 75% of the total standing trees.
- Increase the forest productivity of plantation forests to reach an average of 15 m³/ha/year.
- By 2020, plantation forests shall account for about 3.84 M ha with an annually harvested and replanted area of 0.25 M ha and an average volume of around 150 m³/ha for large timber forests with a growth cycle of 12 years and 70 m³/ha for small timber forests of 7-years rotation.
- Increase the value of timber products from domestic materials, promoting both outdoor and indoor furniture production, minimizing the export of raw products (including wood-chips).
- Timber product structure in the domestic market: furniture: 45%, artificial board: 55% (MDF: 26%, finger joint board: 26%).

Decision No. 5115/QĐ-BNN-TCLN aims at managing the production and processing of woodchips for export to 70% and 40 % of the plantation area for 2015 and 2020 respectively, thus reducing the import of wood material (timber and round-wood) for furniture and other high value wooden products.

Decision No: 2810 /QĐ-BNN-TCLN on the “approval of the action plan for implementation of sustainable forest management and forest certification in the period 2015–2020” issued by the Ministry of Agriculture and Rural Development (MARD) in July 2015 is designed to prepare and implement a SFM system by establishing a national forestry certification system which fulfills internationally recognized certification standards and organizational requirements resulting in at least 500,000 hectares of production forest to be approved under the SFM plan and granted with SFM certification until 2020. Up to July 2016, about 1 % of the total forest area or about 157,000 ha has been certified under the FSC certification scheme. Chain of Custody (CoC) certification is widely applied in the wood processing industry in particular among export-oriented factories to strengthen competitiveness in the international market.

Within the framework of a sustainable forest management system, so far no policies are in place to support the development and promotion of a wood fuel based bioenergy generation system. The promotion of bioenergy from solid biomass for CHP is part of the overall promotion scheme for Renewable Energy (RE) in Vietnam. The National Power Development Master Plan (PDP VII) for the period 2011-2020 with the vision to 2030 sets out the policy framework and targets for power development in Vietnam. The PDP VII explicitly outlines the importance of an increased exploitation and use of renewable sources for electricity production to reduce the

dependence of imported coal-fired electricity, thus contributing to national energy security, climate change mitigation, environmental protection and sustainable socio-economic development. While coal will be the dominant power source with a share of 42.6% of the total electricity generated in 2030, the share of electricity generated by renewable energy sources is planned to increase from 3.7% in 2015 to 10.7 % in 2030. Of the total amount of power from renewables, the share of biomass power is targeted at 2.1%.

The expansion of renewable energy in Vietnam is directed by the Renewable Energy Development Strategy up to 2030 with an outlook to 2050 which provides orientation and specific solutions for implementation. Explicitly mentioned in the strategy is the use of wood substrates from forest land as feedstock material for energy generation and the necessity of developing and applying sustainability criteria for assessing and regulating sustainable bioenergy projects.

The promotion of power and heat generation from biomass is regulated by Decision No.: 24/ 2014/QĐ-TTg “Support Mechanism for the Development of Biomass Power Projects in Vietnam”, issued in March 2014. The regulation is applicable for both single power and combined heat and power systems from biomass and governs (1) the planning and development of biomass power, (2) the incentive mechanism and (3) the implementation arrangements. Key provisions of the mechanism include:

- The national master plan for biomass energy utilization and development for the period 2016–2020 with a vision to 2030, which provides the basis for approval and granting of the investment license. The master plan includes the national and provincial biomass power development plan (BPDP) which is currently being developed by the Ministry of Industry and Trade (MoIT) with assistance from GIZ.
- The regulation of all contractual arrangements between seller and buyer by the power purchase and connection agreement, which provides the basis for granting the investment certificate;
- Incentives for biomass power plants such as tax exemptions for the material and equipment, income tax reduction, land allocation preference and exemption of land use/rental cost, a fixed tariff for selling electricity at VND 1200 equivalent to USD 0.058 per kWh for CHP plants; for single biomass power plants the tariff will be adjusted according to the avoided cost of power generated from imported coal which as of January 2016 was set at USD 0.065 per kWh.

Sustainability issues of the feedstock supply for power and CHP plants are not explicitly addressed at policy level. As part of the planning and approval process at national and provincial level each project has to prove its sustainability by conducting an environmental and social impact assessment.

In chapter 3 an overview of the most relevant sustainability certification systems and initiatives on solid biomass for bioenergy with a focus on woody biomass is provided. Accordingly, the general structure, as well as key elements and actors of a voluntary, market-based certification scheme are described.

Sustainable feedstock supply can be enhanced through different certification systems which, depending on their standard definition, cover either the whole supply chain from cultivation to energy production or only part of the supply chain. SFM schemes basically certify management activities at the forest level while CoC standards allow for monitoring of the subsequent steps along the supply chain. FSC Controlled Wood (CW) only serves for excluding wood from unacceptable sources but does not consider sustainability issues. Emerging system bioenergy certification systems also take GHG emissions throughout the production process of wood substrates into account.

While in Europe and North America certification systems for forest management are widely applied, in tropical regions they are still at an early stage of application mainly due to a lack of enabling conditions. At the moment, the FSC is the dominant SFM certification scheme in Vietnam. PEFC recently started cooperation with the Vietnamese government to develop a Vietnamese national standard for SFM: the Vietnam Forest Certification Scheme (VFCS). The Vietnamese government supports applications for internationally recognized certification (like FSC, PEFC), provides direct financial support and encourages the market development of voluntary certification schemes, especially in the furniture industry.

FSC standards (principles and criteria) are defined according to ISEAL Alliance requirements which outline general characteristics of a good standard. FSC offers three different types of certification including (1) Forest Management certification (FM), (2) Chain of Custody (CoC) certification and (3) Controlled Wood (CW). FM certification applies to the Forest Management Units (FMU), whereas CoC certification targets processors, manufacturers, and retailers of FSC certified products. Certification is verified and

approved by accredited certification bodies. At the moment, about 33 certification bodies run FSC audits worldwide. In Vietnam, the following companies execute FSC audits: CU Control Union Certification (Netherlands), GFA Certification (Germany), Rainforest/Smartwood (USA), SA Woodmark (Britain) and SGS (South Africa).

FSC certification is conducted along a set of generic principals and criteria which are valid at a global level. Relevant indicators are country specific and adapted to the national, regional or local conditions. Vietnam is currently developing their national certification standards which shall be submitted to FSC in 2016 for testing and approval. The certification of plantations plays a crucial role in Vietnam due to the present proliferation of wood chips plantations. Smallholders manage about half of the country's plantations' high cost of certification and lack of capacity prevent a wider application in Vietnam which mainly concerns smallholders. To enable access to those more vulnerable groups, the Small and/or Low Intensity Managed Forest (SLIMF) Certification was introduced by FSC to reduce the burden for smallholders for certification by a lighter set of requirements.

In Vietnam, FSC certification is mainly used to gain market access, e.g. to Europe or the U.S. Therefore, most of the certified products are timber and saw logs used in the manufacturing process of outdoor furniture. As of April 2016, the total FSC FM certified forest area amounts to 157,320 ha or about 1% of the total forest cover. Most of the certified companies simultaneously hold a CoC certificate. Out of the total area of 157,320 ha certified forest (FM), at least 77,500 ha are plantation forests, and at least 13,000 ha serve for protection purposes. Currently, smallholder groups manage about 2,245 ha, i.e. less than 15% of the total certified forest area (including natural forests and plantations). CoC certification is more widely applied in Vietnam, mainly by wood processors to enable better access to export markets. By April 2016, 481 FSC CoC certificates were granted in Vietnam, including a variety of industries such as pulp and paper, printing, NTFPs and furniture. For the category "wood in chips or particles", including wood chips and wood pellets, more than 135 companies are CoC certified.

Currently the World Bank-WWF Alliance for Forest Conservation and Sustainable Use supports forest certification in Vietnam by fostering enabling conditions and raising awareness. Initiated by WWF Greater Mekong, the Global Forest and Trade Network (GFTN) enables FSC certification for small households and facilitates trade links between actors in producer and consumer countries to tackle illegal logging and improve forest management.

Unlike FSC, PEFC does not use interim standards but works with an own national scheme per country. By this, ownership is transferred to the national level. PEFC International Standard (PEFC ST 1003:2010) serves as a benchmark for national certification schemes and includes seven criteria, similar to FSC's principles. In Southeast Asia, PEFC already endorsed some national certification schemes, such as the Malaysian Timber Certification Council (MTCC), and the Indonesian Forestry Certification Cooperation (IFCC). PEFC's activities in Vietnam comprise four focal areas. These are the development of a national scheme, building of cooperative alliances, expansion of pilot projects, and the development of a Group CoC and FM standard. While FSC requirements for certification are high in order to secure higher sustainability standards, PEFC aims at reducing complexity in particular to allow smallholders to join certification. In Vietnam, between 2,000-3,000 ha are being prepared for acquiring PEFC group FM certification – just waiting for the national scheme to be endorsed (PEFC 2015c). PEFC CoC certification standards are similar to FSC and are mainly based on the "percentage based method" and the "physical separation method". As of April 2016, nine valid PEFC CoC certificates have been issued in Vietnam comprising companies in the household and sanitary paper, packaging, printing and the furniture sector.

With the approval of Decision 83 by MARD, the Vietnamese Government started a program for an own Vietnamese FM certification that shall be recognized by PEFC: the VFCS. VFCS is closely linked to the Vietnamese Forestry Development Strategy 2006-2020 and the Forest Sector Reform, facilitating the policy shift from wood chips production to longer rotation periods and, hence, timber production of higher quality for furniture manufacturing and export.

Other solid biomass sustainability certification systems and initiatives however, not yet applied in Vietnam, include the following schemes, (1) International Tropical Timber Organization (ITTO), (2) Sustainable Biomass Partnership (SBP), (3) Better Biomass" - NTA 8080, (4) Green Gold Label (GGL), (5) Roundtable on Sustainable Biomaterials (RSB), (6) International Organization for Standardization (ISO), (7) ENplus and (8) Sustainability Risk Assessment: GRAS and BASIS.

Chapter 4 describes and analyzes a supply chain of solid biomass for CHP systems based on wooden substrates including wood chips from plantation land, wood residues from wood processing and a combination of wooden substrates with other agricultural or agro-

industrial residues in Vietnam. The main concern is the assessment of risks associated to the different stages of the supply chain to ensure a high degree of sustainability and profitability.

Most critical for the quality of biomass feedstock is the energy, ash and moisture content as well as the homogenous structure of the feedstock which directly affect the cost of the supply chain and the conversion efficiency of the CHP system. Freshly harvested wood has a moisture content of approx. 50% which is unsuitable for direct combustion in conventional CHP systems. Air drying of the harvested wood can decrease the moisture content down to 30% which allows for better processing and storage, lower transportation costs and efficient combustion. The moisture content of residues from wood processing is usually low (10-20%), as it has passed a drying process in the factory. Homogeneity and particle size affects the feeding and combustion process and larger sized material decreases the overall heating value.

In Vietnam the main sources of wooden biomass for energy conversion in a CHP system are wooden material harvested from natural and plantation forests, residue material from wood processing and wood pellets. Non-wooden biomass material available as feedstock in Vietnam come from agricultural and agro-industrial sources and include rice straw, left over from corn and cassava harvesting, rice husk and bagasse from rice and sugar processing.

Biomass supply chains can hardly adopt standard procedures for harvesting and handling and requires comprehensive planning and management to assure a constant, high quality supply of feedstock. Feedstock availability and distance to the conversion system often limit the capacity of the conversion system. Legal implications require a wide range of permits, approvals, licenses etc. for the purchasing and handling of the feedstock and an environmental and social impact assessment study and public hearings are requested by the local authorities to decide on the supply of wooden biomass.

A supply chain for wooden biomass (from trees and wood processing) generally comprises of 5 major stages including harvesting and collection, transport, pre-processing, quality control and storage. All stages are interrelated and need to be set and optimized according to the specific site condition of the CHP plant. The actors involved in designing, planning and handling the supply chain are diverse and include a wide range of private and public institutions with varying roles. Organizing and managing a wooden biomass supply is costly and often requires specialized expertise. Contracting of specialized feedstock collectors and refiners to organize and manage a wide range of supply chain activities is common practice and allows CHP plant operators to focus on their core task of efficiently managing the CHP plant. In newly developed CHP markets capable and reliable feedstock suppliers may be lacking, which may require CHP plant owners to manage most parts of the supply chain themselves. Other relevant actors involved include local authorities who provide necessary permits and approvals, experienced local consultants to support the biomass sourcing and approval granting process, investors and banks which need assurance of a reliable and continuous supply of feedstock, and institutions and technical consultants supporting the sustainability certification of the feedstock.

While there are a variety of different approaches to organize and manage the supply chain, two basic models are in place, applicable for a wide range of CHP facilities, namely the producer based and the aggregation contractor based model. For the producer based model the CHP owner signs up with one or several producers of wooden material such as plantation management units for a constant supply of pre-processed feedstock material. The advantage of such a system for the CHP plant owner/operator is better traceability of the material and faster reaction to potential misconduct, longer contracting periods and price stability and a more trustful long term business partnership. The disadvantage of such a model can be the large number of suppliers to be handled, with increased administrative and contractual management efforts. A contractor based supply chain model is a more centralized structure where a contractor organizes and manages most of the tasks along the supply chain. Depending on the capacity of the CHP operator, the contractor services are either limited to sourcing and purchasing of the biomass material or provide a full service package managing the entire chain from harvesting/collection to pre-processing, intermediate storage and delivery. The advantage of outsourcing is that the CHP operator is less involved in the supply chain and can focus more on his core tasks to manage the CHP plant. On the other hand, contracting often limits the possibility of the CHP plant owner to identify and act against illegal and unsustainable practices of the supply chain and increases the risk of being supplied with wooden biomass of illegal origin or unsustainable production.

Sustainability risks are prevalent throughout a wooden biomass supply chain and need to be managed and mitigated at an early stage. Critical risks affecting the environmental and social sustainability of a wooden biomass supply chain are diverse and among others include, land use change for claiming plantation land, plantation management based on a short rotation cycle causing adverse impact on soil, water and biodiversity, illegal logging and import of illegal wood material, allocation of land use rights causing disadvantages for minority groups and communities, legal employment and safety precautions for workers, fossil fuel consumption for handling and

transportation of biomass resulting in increased GHG emissions, and red tape and lack of transparency on granting permits, licenses or approvals by local authorities. With regard to residual wood material from wood processing and pellets production, about 70% of the total amount of wood processed stems from imported wood material, mainly from China, Cambodia, Laos, Malaysia, New Zealand and the US. An option to mitigate risks for both wooden material from plantation or wood residues from processing, including wood pellets, is to purchase wooden material which originates from certified forest management practices or CoC certified material. In chapter 4, major sustainability risks along the supply chain of wooden biomass are described in detail.

Sustainability certification of a wooden biomass supply chain for a CHP conversion plant may be a viable option to mitigate risks. However, certification is costly and will add to the costs of feedstock material which impacts on the overall economics of the CHP system. FM certification costs are made up of two categories, the pre-certification or initial costs to obtain certification and the post-certification costs or annual costs to maintain certification, and are further divided into direct costs and indirect costs. Direct costs comprise of costs covering the certification process, such as auditing, training, stakeholder consultation and certification fees, whereas indirect costs arise for additional management i.e. planning, monitoring, documentation, workers' well-being, mapping, HCV etc., to achieve compliance with the standard. Total costs for obtaining certification differ widely and depend largely on the capacity of the FMU to handle the planning and administrative procedures and the size and type of forest (e.g. natural forest or plantations) to be certified. Because of the complexity of the forest management system, costs of certification for natural forests are usually higher than for plantations. In Vietnam the initial certification cost for a small to mid-sized plantation of ca. 5,000 ha may be up to USD 30,000 and lasts about 2-3 years on average.

Costs of CoC certification are structured in a similar way as FM certification with direct and indirect costs to cover the costs of the certification process and the management costs to ensure compliance. Being less complex, CoC certification costs are lower than FM certification costs. For a 5-year certification period, initial auditing and annual surveillance costs may range between USD 5,000 – 10,000. From a survey conducted in Malaysia, CoC compliance costs were assessed and amounted to about USD 1.33 per m³ of wood material.

Benefits of certification can be monetary or non-monetary and are classified as direct and indirect benefits. Usually price premiums are paid for certified products but differ widely, depending on market demand and product type. Certified wood products are favored by European, American and Japanese markets and premiums can be as high as 20% compared to non-certified products. Other direct financial benefits can be tax reductions and subsidies as well as additional revenues from the "Payments for Eco-Services" (PES) and the sale of certified carbon emission reduction either under existing compliance (CDM) or voluntary (VER) trading schemes.

Indirect benefits of monetary value are mainly achieved through improved operational efficiency, i.e. by applying the method of reduced impact logging (RIL) and more efficient marketing which positively affects the overall profitability. Indirect benefits of non-monetary value are environmental and social benefits derived from improved forest operation and management and lead to enhanced biodiversity and ecological functions of the forest, improved soil, water and air conditions, reduced GHG emissions, improved working conditions and social security.

Though the benefits from FM and CoC certification are obvious and highly relevant to mitigate sustainability risks, many of the benefits cannot be quantified directly in monetary terms which raises concern whether the return of investment from certification is sufficient to make certification an attractive tool to manage the risk associated with forest management.

Referring to the CHP project currently being developed by PROLIGNIS in Vietnam, a case study reflects on the option of using certified wooden feedstock material as a potential way to mitigate sustainability risks. Designed with an overall electrical capacity of 2.8 MW to meet the factories annual electricity demand of about 19,000 MWh all heat and power will be directly supplied to the manufacturing plant a German enterprise with production facilities located near Hanoi.

The fuel price for a CHP system depends on the price of the material and associated supply costs and usually represents 50-70 % of the running costs of the plant. A reliable and constant supply of quality feedstock is a major requirement with direct impact on the economic viability of the CHP system. Moreover, the feedstock supply needs to prove environmental and social sustainability. Based on the result of a sourcing study for available feedstock in the proximity of the CHP, it was decided to use wood chips from plantations as the main source of feedstock. With nearly 7 M tons of wood chips produced in 2014, Vietnam is one of the largest wood chip producers in the region. Currently, 70% of the plantation wood is harvested for wood chips production, mainly for export, causing strong competition for raw wood material, unpredictable pricing and unsustainable plantation management. PROLIGNIS is aware of the sustainability risks associated with a wood chips supply chain and therefore plans to sign long term purchase orders for

wood chips or wooden raw material directly with FMU forest producers or contractors with a reliable track record of sound management and business practices or alternatively, invest directly into plantation forests. To overcome potential sustainability risks in designing and managing a wood chips supply chain from plantations, PROLIGNIS has hired the German Consulting company FOREST FINEST CONSULTING (FFC) to provide advice on the sourcing and management of plantations for sustainable and reliable wood chips production.

Based on the designed firing capacity of the CHP plant, a total amount of 31,500 tons of wood chips is needed to meet the fuel demand for the CHP system. Assuming a productivity of 30 m³/ha and year and harvesting rate of wood of 100, 60 and 40 % the total plantation area of about 1,200, 2,000 and 3,000 ha, respectively would be required to meet the wood chip demand for the CHP plant.

Based on cost estimates by PROLIGNIS and FFC, the costs for wood chips production for the CHP plant would approximate 50-60 USD/ton fresh (50 % moisture content). The costs include additional costs for sustainable forest management practices complying with FSC or PEFC management standards but exclude direct certification cost such as auditing, capacity development and associated certification fees. Depending on the size of the plantation area, the terrain and management capacity of the FMU, direct certification cost for FM and CoC pre-certification and ongoing verification vary and range between of around USD 20,000 – 30,000 per year, resulting in an increase of the unit cost of feedstock of about 0.75-1.5% or USD 0.4-1.0/ton.

Since environmental and social sustainability of the supply chain is a key requirement for PROLIGNIS and being aware of the unsustainable practices of plantation management for wood chips production, PROLIGNIS considers to design and implement the supply chain along the FM and CoC standards as defined by FSC or PEFC.

A wood chips fuel supply chain from plantation comprises of GHG emissions during all stages of the supply chain, including land use change and consumption of fossil fuels for harvesting, processing and transportation. Particularly for transportation, the bulky nature of wood chips can be a major factor contributing to GHG emissions of the supply chain. At the same time plantation land, if established on marginal land with sparse vegetation and sustainably managed, mitigates GHG emissions through carbon storage and sequestration. Certification of GHG emission reduction along the supply chain may be an additional option to add value to the CHP system. The Gold Standard Foundation (GSF) has developed different standards to certify environmental (primarily GHG reductions) and sustainable development impacts from activities in the energy, waste, land use & forestry and water sectors. With the new GSF 3.0 standard a comprehensive GHG certification along the bioenergy value chain, from the forest to the CHP conversion system, could be established. GHG emission reduction of approx. 20,000 – 27,000 tons CO₂ per year could be achieved which, assuming a sales price of 4 USD/CER, could generate an additional revenue of 80,000 - 110,000 USD/year, depending on the size of the plantation area.

Two business models are being considered to manage the supply chain, (1) PROLIGNIS in partnership with FFC invests into plantation land and handles all stages of the supply chain independently or (2) PROLIGNIS in partnership with FFC signs up with one or several plantation companies for the procurement of feedstock. Both models are suitable to ensure a sustainable feedstock supply chain, whereas the plantation investment model allows for better control of a reliable and steady supply of feedstock under predictable and long term price conditions. The main disadvantage would be the time delay for the initial harvesting of the wooden material. From the sustainability point of view, more efforts towards risk management would be needed for the contracting model, for which CoC certification would be needed to control the certified feedstock supply. A combination of both models – investing and contracting - seem to be a feasible way to design and manage the supply chain, balancing the risk of high capital investment for plantation land with the need to control a sustainable feedstock supply under predictable economic conditions.

In conclusion, wooden biomass material, if sustainably generated and supplied, is a valuable resource for bioenergy conversion. Vietnam is rich in forest land and wood processing, providing vast resources for the bioenergy sector to contribute to the achievement of the national targets for renewable energy, thus enhancing energy security, fossil fuel replacement and GHG emission mitigation. So far however, woody biomass is not being utilized for energy purposes, including for CHP conversion mainly due to insufficient legal framework conditions and incentive policies to stimulate investment and to a forest policy supporting wood chips production for export, utilizing 70 % of the all timber harvested from plantation land. With newly adopted policies and support mechanisms in the forestry sector, the Vietnamese government is shifting from export-oriented wood chips production towards an integrated approach of sustainable forest management and a higher value material utilization. Yet, the utilization of wooden biomass for bioenergy has not

been included in the forest reform, missing out on the opportunity to tap the synergies arising from sustainable forest management and bioenergy development.

FM and CoC certification addresses sustainability risks, both on forest and on supply chain level. With just slightly over 1% of the total forest land certified, certification is not widely applied in Vietnam, mainly because of its complexity in application, lack of capacity and uncertainty in regards to costs and return on investments. A national certification scheme is currently being developed in cooperation with PEFC, targeting an area of 500,000 ha to be certified by 2020. Designing and implementing a wood fuel supply chain for CHP in Vietnam is challenging and bears risks all along the chain. Risk factors such as a lack of reliable data on the forestry sector, a time-consuming and rather unpredictable licensing and approval process and a highly competitive wood chips sector tarnish sustainability and need to be taken into account when designing and managing a sustainable supply chain.

The German project developer PROLIGNIS is currently developing a CHP project in Vietnam feeding on untreated wood chips from plantations. Looking at the huge potential of wood chips from plantations in Vietnam, which are mainly utilized for exportation, the project may serve as a case study to review and adopt policies and regulations towards the promotion of wooden biomass material for heat and power generation. The project is to be developed at the highest sustainability level to ensure full compliance with internationally recognized standards, thus stimulating a broad recognition for wood fuel based CHP among relevant stakeholders, including policy makers, financing institutions and the public in general.

Introduction

1.1 Structure and focus of the subsector analysis

Around the world, government and private sector initiatives emerged in order to face sustainability challenges in the bioenergy sector. As a result, sustainability certification of biomass for energy purposes gains importance as a voluntary, market-based approach to mitigate risks and negative side effects. This subsector analysis is directed at private sector actors such as project developers who plan to engage in the Vietnamese bioenergy sector. Moreover, it sheds light on private sector challenges and informs public entities and decision-makers about needs for adaption of the regulatory framework. The objective is to give guidance to analyze risks along the supply chain, to assess which certification scheme best addresses those risks, and to get a first understanding of both the costs and benefits of sustainability certification. The following chapters summarize the findings from desktop research, academic literature review and on site interviews with experts in Germany and Vietnam. Solid biomass in this analysis refers exclusively to feedstock from wood and wood residues while other substrates (e.g. rice straw and rice husks) are not covered. Wood fuels can be categorized according to their source, ranging from (1) the energy crop such as (plantation) trees, (2) direct by-products from thinning and logging as well as indirect by-products from the wood processing industry to (3) end use materials like recovered and used wood (FAO and UBET 2012; Goh and Junginger 2011; Krajnc 2015). Although the last category is not further discussed here since there is no wood waste recovery strategy in Vietnam yet, it most likely has great potential as an important and ecofriendly source of solid biomass.

The subsector analysis focuses on sustainability certification but refers to basic legal requirements as well. “Illegal wood” can be defined as “wood that comes from illegal sources, such as wood illegally imported, illegally obtained, as through the use of false documents or by smuggling, or involving species that are banned in international trade” (Cota Gomes et al. 2002: 42). Sustainability by contrast is a holistic approach that goes beyond mere legality considerations and includes the social, economic and environmental dimensions. Despite best intentions, there remain limitations by the nature of certification as a tool to mitigate negative impacts, in particular indirect effects such as indirect land use change (ILUC) or increased wood prices (NL Agency 2013).

After a brief introduction to the general sustainable bioenergy debate and current initiatives in the European Union and Germany, chapter 2 outlines framework conditions and legal requirements, including key policies, both for the Vietnamese forestry and bioenergy sector. Chapter 3 gives an overview of the structure and elements of a sustainability certification scheme in general, compares different CoC models, depicts the current status of different forest certification systems in Vietnam, and points to further certification alternatives for sustainable bioenergy. Based on possible sources of wooden biomass, chapter 4 analyzes potential supply chain options, some inherent sustainability risks and how they can be mitigated. Following, chapter 5 serves for a better understanding of costs and benefits concerning sustainability certification of solid biomass, also by referring to a case study.

1.2 Sustainable bioenergy debate

Expectations for bioenergy as a renewable energy source and a way for climate change mitigation are high. A variety of biomass types, from solid biomass to liquid biofuels, are used for transportation, for heat and power generation as well as for cooling. Specifically, woody biomass shall contribute to the European Union’s 2020 renewable energy targets (AEBIOM 2013). While this form of energy is expanding, critics increasingly raise concerns about the sustainability of bioenergy in terms of ecological and socio-economic consequences. The potential “food vs. fuel” competition caused by the use of liquid biofuels from originally food crops is just one aspect of the ongoing debate. Although this competition is less intense in cases where wood is used for energy generation, there are other crucial impacts – positive as well as negative ones – that have to be assessed thoroughly. This is all the more important when feedstock comes from developing countries or the technology is used there.

In the European Union existing laws and public awareness may mitigate major harm from bioenergy whereas this might not be the case in other regions of the world. Potential impacts concern the social, the economic as well as the environmental dimension. Rural areas where biomass is produced may benefit from the provision of jobs and income and, hence, an increase in social welfare (FAO and SEI 2010; Lahtinen et al. 2014). Likewise, local available feedstock for bioenergy not only supports the nearby economy but also increases independence from energy imports (GIZ 2014). At the same time land right conflicts may arise between local communities and bigger for-profit forest companies. One positive environmental effect of “carbon-neutral” bioenergy is its contribution to climate change mitigation when renewable biomass replaces fossil fuels. Another effect is its potential for restoring degraded lands. Yet,

carbon-neutrality is subject to an ongoing debate and the real greenhouse gas (GHG) impacts depend on a wide range of factors throughout the whole lifecycle. Equally, unsustainable production of woody feedstock may lead to the conversion of natural forests to plantations, as well as the uncontrolled expansion of plantations and therefore to a loss of biodiversity (NL Agency 2013; FAO and IEA 2010).

In the Vietnamese context, bioenergy from wood can contribute to the country's energy mix and climate targets by increasing the share of renewable energy and simultaneously reducing the dependence on fossil fuels. Regarding the private sector industry, biomass based CHP systems at production sites enhance the reliability of power supply. Although the power quality has been improved significantly in the last two years, with fewer power cuts, the increasing power demand especially in industrial zones poses a challenge. Biomass CHP systems not only assure constant power generation but can also provide heat, steam as well as cooling. Moreover, purchasing heat and power from a nearby biomass CHP system will ensure long-term stability and predictability of energy prices. Besides wood material from plantations or landscaping, the residues of the extensive Vietnamese woodworking industry have not yet been considered but offer a further potential source of CHP-feedstock. For these reasons, bioenergy stands for greener energy, price hedging and quality improvement at the same time. Nevertheless, in order to be beneficial for both people and the environment, potential negative impacts have to be considered. A decisive factor is the growing demand for wood products and a related possible gap between supply and demand: 80% of timber processed by the Vietnamese furniture industry has to be imported not only from the Southeast Asian region (e.g. Laos) but also from Brazil or the U.S.; at the same time the majority of wood chips from local plantations is exported and used amongst others for energy generation in countries in the region like Japan, China, and South Korea (GIZ Vietnam 2015; ETTF 2016).

1.3 Initiatives in the European Union and Germany

Regarding solid biomass produced in the European Union, the sustainability risk is considered low owing to the existing legal framework conditions in the agriculture and forest management area. However, increasing demand for biomass will also lead to increasing imports from developing countries with laxer regulations and therefore to a higher sustainability risk. For that, voluntary as well as mandatory certification systems and regulations emerge at national level within the EU – but they are not always compatible with each other (EC 2010). Up to April 2016, there had been no mandatory, EU wide regulation concerning sustainability of *solid* and gaseous biomass for energy purposes. The Renewable Energy Directive (Directive 2009/28/EC) only outlines a sustainability framework for biofuels used for transportation and bioliquids (Fritsche et al. 2014). In its 2010 report on “sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling”, the European Commission made non-binding recommendations to member states. Those recommended criteria are comparable to the existing ones for biofuels and bioliquids, and are applicable for biomass plants of at least 1 MW electric or thermal capacity. Moreover, the European Commission (EC) recommended the design of incentives for higher efficiency of bioenergy plants as well as improved biomass statistics. In 2014, the EC analyzed key sustainability aspects, the potential impact on the internal market, and the progress made since 2010. By then, a few member states had adopted sustainability schemes with no noticeable distortions for the internal market (EC 2014).

Nevertheless, there is need for one consistent policy for all EU member states. The European Commission is likely to include sustainable biomass policies and legislation in a new Renewable Energy Package in 2016/ 2017 (AEBIOM 2015). In the realm of its preparation, the EC started a stakeholder survey, from 10 February until 10 May 2016, with the objective of consulting stakeholders and citizens on an updated, EU wide sustainable bioenergy policy for the time period 2020-2030 (EC 2016). Independent from the energy use, forest biomass and related legality risks are also subject to the EU Timber Regulation (Regulation (EU) No 995/2010). The regulation became effective in March 2013. Moreover, the new EU Forest Strategy sets the ambitious target for 2020 that “all EU forests are managed according to the principle of sustainable forest management (SFM)” (EC 2014). Some EU member states introduced sustainability regulations for solid biomass. The focus lies mostly on avoided GHG emissions and/or energy input along the whole supply chain, on traceability and origin of the feedstock as well as on sustainable forest management practices (Goh and Junginger 2011; EC 2014).

Table 1: National sustainability regulations for solid biomass for energy use

Country	Regulation/ Incentive mechanism
Belgium	Flemish Green Power Certificates (FL-GSC) Walloon Green certificate granting system (Wall-CV) Brussels Green certificate granting system (Bru-CV) Financial incentives related to GHG savings, SFM requirements for forest biomass
Hungary	SFM requirements for forest biomass
Italy	Minimum GHG saving threshold for forest biomass
United Kingdom	Renewables Obligation (Amend.) Order 2010 (RO) Scottish Biomass Heat Scheme (SBHS) Minimum GHG saving threshold for solid and gaseous biomass, land use criteria for agricultural biomass, timber standard for woodfuel for heat and electricity
Netherlands	NTA 8080: norm for sustainable biomass Sustainability criteria proposed by the Cramer committee GHG saving performance, forest carbon stock and ILUC impacts

As of April 2016; Sources: Goh and Junginger 2011; EC 2014

Based on the European Renewable Energy Directive, the German government entrenched targets and measures for the bioenergy and biomass development in the following plans (FNR 2016):

- “Nationaler Biomasseaktionsplan für Deutschland” – National action plan for biomass by the Federal Ministry of Food and Agriculture (BMEL) and the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) in 2009
- “Aktionsplan für Erneuerbare Energien” – Action plan for renewable energy by BMUB in 2010
- “Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung” – Energy concept for an ecofriendly, reliable, and affordable energy supply by the Federal Ministry for Economic Affairs and Energy (BMWi) and BMUB in 2010

As measures of the action plan and the energy concept, two *mandatory* sustainability regulations entered into force in 2010, which implement the sustainability aspects of the European Renewable Energy Directive at the national level (BLE 2014):

- “Biomassestrom-Nachhaltigkeitsverordnung” (BioSt-NachV) – Biomass Electricity Sustainability Regulation
- “Biokraftstoff-Nachhaltigkeitsverordnung” (Biokraft-NachV) – Biofuel Sustainability Regulation

Applying to all forms of liquid biomass as well as to liquid and gaseous biofuels for transportation, these sustainability regulations determine the way of production according to specific sustainability requirements like the prohibition to destroy any high conservation value forests (HCVF) and high protection areas, or the reduction of GHG emissions compared to fossil fuels. Certification systems and certification bodies accredited by the Federal Office for Agriculture and Food (BLE) ensure that the requirements are met (BLE 2010). By the end of 2014, there were two accredited certification systems, namely the International Sustainability and Carbon Certification (ISCC) and REDcert, which are applied by 26 certification bodies. In 2013, they certified more than 857 companies. Besides the two acknowledged “DE-systems”, the European Commission approved 18 voluntary certification systems (e.g. Bonsucro, Roundtable on Sustainable Biofuels (RSB), NTA 8080; as of 2014) that are also applicable in Germany. In 2014, 342 companies received a certificate according to the “DE-systems” and about 2,500 companies according to the voluntary schemes (BLE 2014; BLE 2015).

Nonetheless, there had been no binding national legislation on sustainability of solid biomass up to April 2016 despite its importance for the national power supply: wood-fired plants (including CHPs) generated about 2.5% of Germany’s total electricity demand in 2013 (BASIS 2015). National laws like the Federal Forest Act (BWaldG), the Federal Nature Conservation Act, and the Plant Protection Act, combined with provincial laws regulate the production of solid biomass for energy within Germany. In addition, voluntary certification schemes for SFM are prevalent in Germany. Out of the total forest area of almost 11 M ha, more than 71.69% are certified, mainly by the PEFC standard but also by the Forest Stewardship Council (FSC) standard (BASIS n.d.). As mentioned above, this is not sufficient for ensuring sustainable feedstock supply from outside Germany and Europe. Since recently, two

initiatives closely cooperate and aim at developing a consistent standard for wood chips at national level. One objective of the qualiS¹ project is to analyze market conditions and potential as well as quality requirements for premium wood chips, and to develop suitable quality assurance systems. The “HackZert”² project also works on a certification scheme for premium wood chips. Yet, both focus on the quality dimension and not explicitly on the sustainable origin of the feedstock (BBE 2016). Similarly, the European norms DIN plus and EN plus (cf. chapter 3.2.3) specify only quality requirements for pellets used by industry and end-consumers respectively.

¹ “qualiS - Brennstoff-Qualifizierung und Qualitätsmanagement in der Hackschnitzelproduktion als Beitrag zur Emissionsminderung und Nachhaltigkeit” by the federal association for bioenergy (BBE) and partners

² “HackZert - Entwicklung eines Zertifizierungsprogramms für Holzhackschnitzel” by the German Pellet Institute (DEPI) and partners

2 Framework conditions and legal requirements

The economic development in Vietnam is governed by various national strategies including the National Socio-Economic Development Strategy (SEDS) 2011-2020 and the National Green Growth Strategy (NGGS) 2011-2020 with a vision to 2050 (Decision No. 1393/QĐ-TTg - Approval of the National Green Growth Strategy), endorsed by the Prime Minister in November 2011 and September 2012, respectively. Both strategies emphasize a sustainable economic development based on a competitive market approach by protecting natural resources, safeguarding social stability, strengthening environmental protection and to mitigate and to prevent the adverse impacts of climate change.

Along the socio-economic and green growth development approaches, sustainable forest management for environmental protection and productive use as well as the conservation of energy and an increased application of renewable energy to replace fossil fuel are being targeted. Based on those national development strategies the respective Ministries have laid down specific sector policies and master plans for implementation to achieve the overall national targets. The following sections will briefly describe and analyze the strategies and policies of the two sectors.

2.1 Forestry and wood fuel

2.1.1 Overview of forest sector and wood production

The forestry sector of Vietnam over the last four decades has passed through various stages of development. In 1943 Vietnam had 14.3 M ha forest land, resulting in a share of 43% of forest cover; by the year 1990 only 9.18 M ha remained, equivalent to a 27.2% share of the total land area. During the period 1980 – 1990, the average forest loss was more than 100,000 ha each year. From 1990 to the present, the forest area has been increased gradually, due to afforestation and rehabilitation of natural forest as well as the large increase of production (plantation) forest. As shown in Table 2, according to national statistics the total land area covered by forest by the end of 2013 increased to around 14 M ha of which 9-10 M ha or about 75 % was covered by natural forest and 3.5-4.0 M ha or approx. 25.5 % by plantation forest. Thus, over the last 15 years the forest cover has steadily increased from a 32% share to about 42% of the total land area. The rapid increase of forest area can mainly be attributed to the setting of a comprehensive legal framework with numerous supporting policies for its implementation. Emphasis was laid on the conservation of natural forest, the economic use of converted or newly planted forest for timber production, woodchip and fiber as well as change of ownership rights to allow communities and other private sector institutions to take part in forest management and production.

Table 2: Forest coverage by type of forest

Forest type	Size (in ha)	Share (in %)
Natural forest	10,398,000	74.5
Plantation forest	3,556,000	25.5
Total forest area	13,954,000	100.0

As of end 2013; Source: Statistical Yearbook 2014

As illustrated in Figure 1, the amount of timber harvested from domestic natural forests and plantations in 2013 totaled approx. 17 M m³ RWE. Of that amount, 12 M m³ or 70% was processed to wood chips, mainly made for export (ViFores 2013) to China, Korea and Japan. The remaining 5 M m³ or 30% of the total production was largely used for domestic purposes mainly for medium-density fiberboard (MDF) and plywood production, pulp and paper and carpentry. At the same, due to the growing demand for quality timber mainly for furniture production, in 2013 about 4 M m³ RWE or 30 % of the total wood processed was imported.

The total export turnover of timber products in 2014 was around 6.3 billion USD whereas the import of timber material (mainly round- wood and sawn wood) amounted to about 2.5 billion USD. Major export markets for processed timber, mainly as indoor and outdoor furniture, are the U.S., China, EU and Korea while most of the imported timber originates from the neighboring countries, Laos and Cambodia as well as US, China, Malaysia and EU (Forest sector development report 2014).

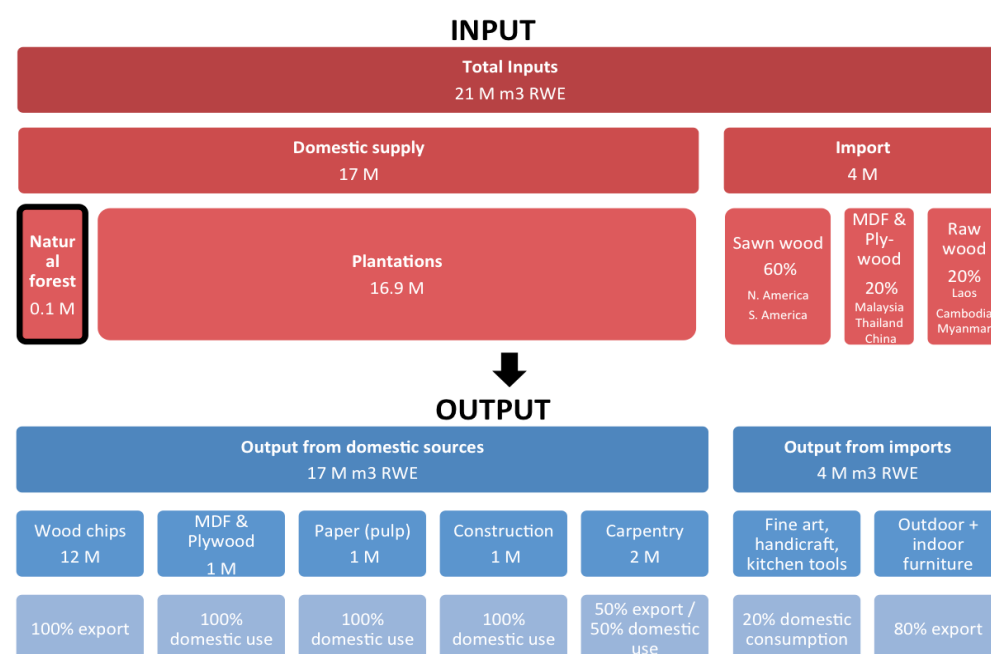


Fig. 1: Input and Output of Vietnam's timber industry

Source: GIZ Vietnam according to ViFores for the year 2013

The amount of wood chips exported during 2012 – 2014 ranged between 6-7 M dry tons/year resulting in an annual export value of 800 to 950 M USD. The strong demand for wood chips is to a large extent driven by the expansion of renewable energy using wood chips as a fuel source for bioenergy.

Table 3: Wood chips export

Date	Amount (M tons dry)	Value (M USD)
2012	5.82	796.35
2013	7.06	983.39
2014	6.97	958.04

Source: Tô Xuân Phúc (Forest Trends), Trần Lê Huy (FPA Binh Dinh), Huỳnh Văn Hạnh (HAWA)

2.1.2 National legislation and policies

Vietnam's forestry sector is governed by the **Forest Protection and Development Law** (No. 29/2004/QH11) which was promulgated in December 2004. The law divides forestland into three categories (VNForest 2013):

Box 1: Categories of forestland in Vietnam

- **Protection forests**, with the main purpose to protect water sources and land, prevent erosion and desertification, restrict natural calamities and regulate climate
- **Special-use forests**, mainly for nature conservation and biodiversity, as well as to provide recreation in combination with protection including national parks and nature conservation zones, nature reserves and species-habitat conservation zones
- **Production forests**, from natural production forests and plantations which are used mainly for production and trading of timber and non-timber forest products in combination with protection, contributing to environmental protection

Source: VNForest 2013

Consistent with the Land Law, the Law on Environmental Protection and the Biodiversity Law the Forest Protection and Development Law (No. 29/2004/QH11) provides a comprehensive legal framework for the forest sector development in Vietnam, stipulating the principals of forest management, protection and development of forests as well as owner's rights and obligation to

utilize forest land for income generation. Based on the legislative framework, the Vietnam Forestry Development Strategy 2006-2020 was promulgated by Decision No. 18/2007/QĐ-TTg in February 2007, which sets out the key strategies for the development of the forest sector until today. Under the Vietnam forestry development strategy, the Forest Protection and Development Plan for the period 2011-2020 (decision No. 57/QĐ-TTg from January 2012) was developed, which provides the guiding framework for the implementation of the strategy.

Aiming at sustainable, effective and socially inclusive forest management, the plan has targeted an increase of the forest cover to 42-43% and 44-45% to 2015 and 2020, respectively. Currently, out of the total land area of 33 M ha around 14 M ha is covered by forest which translates to around 41% and goes well along with the set target. From the total forest cover of 14 M ha, about 10.4 M ha or 74% is natural forest (protection and special use forest) and 3.55 M ha or 26% is plantation forest (production forest). Newly planted forest in 2013 was about 227,000 ha whereby 211,000 ha accounted for plantation forest, 14,000 ha for protection forest and 1,400 ha for specialized forest (Statistical Yearbook 2014). The remarkable increase of forestland over the last decade is mainly attributed to a policy of transformation from a state owned economy towards a more open and liberal framework allowing the private sector and the public to play an instrumental role in the development process. While most of the forestland is still in the hands of state owned institutions, approx. 25% of the total forestland and 50% of the plantations respectively is owned and managed by small holders on household level.

Under the Forestry Masterplan 2011-2020 the following key policy measures regulating the forest sector are currently in force:

- **Notification No.456/TB-VPCP** on the conclusion of the Prime Minister on “Proposal on Strengthening the management of natural timber harvesting for the period 2013- 2020” from Dec. 2013 (VNForest 2014) and **Decision No.: 2242/QĐ-TTg** from December 2014 “Approving the scheme for strengthening the management of exploitation of timber of natural forest for the period 2014-2020”, which basically imposes a logging ban on natural forest to restrict the illegal timber exploitation and to properly protect the existing area of natural forest.

Decision No 1565/QĐ-BNN-TCLN of July 2013 “**On approving the Forestry Sector Reform Proposal**” which is directed towards developing a forestry sector that is economically, socially and environmentally sustainable and gradually shifts the growth towards improved quality, efficiency and competitiveness. In particular, the decision aims at (1) increasing the values-added of forest environmental products and services; (2) raising the annual average production values by 4-4.5% to gradually meet with demand of timber and timber products for domestic markets and export, thus (3) contributing to job creation, poverty alleviation, livelihood improvement and environmental protection to aim for a sustainable development. In order to the aforementioned objectives, the following sub-goals serve as orientation:

- **Forest structure**
 - To increase the forestland area to be around 16.2–16.5 M ha in 2020, composed of 8.1 M ha production forest, 5.8 M ha protection forest and 2.2 M ha special use forest.
- **Added value to the sector**
 - To improve transparency of forest production and management by adopting the CoC approach, covering the whole supply chain (from planting to consumption)
 - Increase the timber reserve of natural production forests by 25% against the current volume, achieving the average growth of 4-5 m³/ha; improve the quality of natural forests to ensure a commercial timber proportion of 75% of the total standing trees.
 - Increase the forest productivity of plantation forests to reach an average of 15 m³/ha/year.
 - By 2020, plantation forests shall account for about 3.84 M ha with an annually harvested and replanted area of 0.25 M ha and an average volume of around 150 m³/ha of big timber forests with a growth cycle of 12 years; 70 m³/ha for small timber forests following a growth cycle of 7 years.
- **Develop timber processing industry**
 - Reform the structure of timber and NTFP-based products, especially for exports by increasing the values of timber products made from domestic materials, promoting both outdoor and indoor furniture in a harmonized manner, minimizing the export of raw products (including wood-chips).

- Timber product structure in the domestic market: furniture: 45%, artificial board: 55% (MDF: 26%, finger joint board: 26%).
 - Production of artificial board: 2.3 M m³ of products in 2015, 0.3 M m³ of products in 2020 and 3.9 M m³ of products in 2030.
 - Production of furniture: domestic furniture: 2.8 M m³ of products in 2020 and 4.0 M m³ of products per year in 2030; furniture for exports: 5.0 M m³ of products in 2020 and 7.0 M m³ of products in 2030.
 - Increase the utility of domestic material timber to reduce imported material timber for the timber processing industry. By 2015, domestic material timber available to supply to the processing industry shall reach 10.5 M m³, meeting around 50% of demand; by 2020, the productivity shall be 14.5 M m³, satisfying 62% of demand; by 2030, the productivity shall be 24.5 M m³, satisfying 75% of demand.
 - Support timber processing enterprises and industries to improve capacity, product quality and business development.
- **Decision No. 5115/QĐ-BNN-TCLN** of December 2014 “On approval for the plan for woodchip production management in the period 2014 – 2020”. The decision aims at strictly managing the production and processing of woodchips for export, to limit the utilization of plantation forest for woodchips production to the maximum extent. This should contribute to an increased value of products from plantation forests, which should improve the livelihood of small holder’s forest owners thus contributing to poverty reduction. During the period 2014–2015 wood processing firms were allowed to use a maximum of 70% of wood material harvested from plantation forests to produce woodchips, resulting in an added value per 1 m³ of wood material by 14% compared to 2013. For the period 2016–2020 a maximum of 40% of wood material harvested from plantation forests is left for woodchip production, increasing the added value per 1 m³ of wood material by 54% compared to 2013. The measure shall contribute to the reduction of imports of wood material (timber and round-wood) to be further processed to furniture and other high value wooden products.
- For the implementation of the new plan for wood chips production and management the government has issued a number of support instruments including:
- Taxation by increasing export tariffs on wood chips from 0% to 5-10%, issuing a 10% value-added tax, as well as a 25% corporate tax for enterprises (currently 22%) involved in woodchip production.
 - Establishing a credit incentive policy for forest owners who invest in new forest plantation for big timber or maintain existing ones and extend their rotation cycle to minimum 10 years for large timber by adjusting maturity of loans to the rotation length with preferential interest of no more than 5%/yr and principal and redemption payments to be made one time after harvest.
 - Encouraging enterprises to invest in developing processing facilities in rural areas using domestic plantation timber (in compliance with regulations) to produce high value wood products for the domestic market and export, by reimbursing **full VAT, exemption from factory land lease and support 50% of material transportation cost for the first 5 years of operation;**
 - Support technology transfer for producing subsidiary material used in the wood processing industry.
- **Decision No: 2810 /QĐ-BNN-TCLN** “Approval of the action plan for implementation of sustainable forest management and forest certification in the period 2015–2020” issued by MARD in July 2015. The decision is primarily designed to prepare and implement a SFM system by establishing a national forestry certification system, which fulfills internationally recognized certification standards and organizational requirements. Through this newly developed action plan at least 500,000 hectares of production forest shall have an approved SFM plan and granted with SFM certification until 2020. Compared to the current status of FSC certified forest area of about 157,000 ha (FSC fact and figures, July 2016), this would be an increase of about 70% to be achieved over the next 5 years.

In order to further expand the trade of quality wood products, in particular to Europe, the government of Vietnam has been negotiating with the European Union on the VPA-FLEGT agreement (Voluntary Partnership Agreement on Forest Law Enforcement, Governance and Trade). VPA-FLEGT is a voluntary binding agreement which addresses the legality of the wood product along the value chain from its origin to the end user. First negotiations on the agreement started in October 2010, and up to date a final agreement could not be reached. Two important issues of the agreement are the legality definition (LD) and a Timber Legality Assurance System (TLAS), which has not been completed and is under ongoing negotiation. The agreement is expected to be signed by the end of 2016.

In conclusion, the legislation framework of the forest sector development with its underlying strategy, policies and regulations is clearly directed towards expanding forest cover, mainly through the expansion of plantation forest. At the same time sustainable forest management becomes the focus of the sector development, emphasizing a balanced approach between forest protection to ensure a high degree of biodiversity, social justice for land allocation and ownership and a higher efficiency of forest production for increased value added from plantation timber production. So far no legal requirements are in place for the certification of forest management (FM) and up to now about 1% of the forestland is certified. CoC certification is widely applied in the wood processing industry in particular among export-oriented factories to strengthen their competitiveness through better access to international markets. The setting up of a national certification system for FM and CoC is currently being developed and shall enable a broader application of certification in the future.

The use of wood material from forest or wood processing as feedstock material for the use of domestic energy generation is not being addressed in the legal framework. Accordingly, no support initiatives are being undertaken to develop a wood substrate based energy generation system as an integrated part of a sustainable forest management system.

2.2 Bioenergy from solid biomass

2.2.1 Legal framework and key policies

The promotion of bioenergy from solid biomass for power or combined heat and power generation (CHP) is part of the overall promotion scheme for RE in Vietnam. Besides small hydropower, wind energy, solar photovoltaics (PV) and waste-to-energy (municipal waste), the utilization of solid biomass from agricultural and agro-industrial sources is being considered as a major technology towards RE development in Vietnam.

In the **Decision No. 1208/QĐ-TTg** issued by the Prime Minister in July 2011 on the “Approval of the National Master Plan for Power Development for the Period 2011–2020 with the Vision to 2030”, replaced by the **Decision No.: 428/QĐ-TTg** issued in March 2016 on the Approval of the Revised National Power Development Master Plan (PDP VII) for the period 2011-2020 with the Vision to 2030, is the key policy framework for power development and sets out the targets and direction for grid connected power development in Vietnam. On the basis of the master plan, provincial power development plans are being developed for the implementation of the master plan.

With the overall objective to “ensure an adequate power supply with increasing quality and a reasonable electricity price for the country’s socio-economic development by utilizing available primary energy sources for electricity production in diverse and efficient manners”, the master plan explicitly outlines the importance of an increased exploitation and use of renewable sources for electricity production in order to reduce the dependence of imported coal-fired electricity thus contributing to national energy security, climate change mitigation, environmental protection and sustainable socio-economic development. Based on the assumption of an annual economic growth rate (GDP) of 7% from 2016 until 2030, the power demand is expected to grow to approx. 235-245 billion kWh in 2020, 352-379 billion kWh in 2025 and approx. 506-559 billion kWh in 2030. In accordance with the expected demand, the targets for production and import of electricity were set to approx. 265-278 billion kWh in 2020; approx. 400-431 billion kWh in 2025 and approx. 572-632 billion kWh in 2030. The targets of the total installed capacity of power plants are approx. 60,000 MW in 2020, 96,500 MW in 2025 and 129,500 MW in 2030. The following tables provide an overview of the structure of power sources in percentage of produced electricity and installed capacity over the period 2020–2030 as outlined in the revised PDP VII.

Table 4: Structure of power sources in percent of total electricity production

Power Sources	2015	2020	2025	2030
Renewable Energy	3.7 %	6.5 %	6.9 %	10.7 %
Coal	34.4 %	49.3 %	55 %	53.2 %
Natural Gas	30.0 %	16.6 %	19.1 %	16.8 %
Hydro	30.4 %	25.2 %	17.4 %	12.4 %
Import	1.5 %	2.4 %	1.6 %	1.2 %
Nuclear	-	-	-	5.7 %

Source: GLZ Energy Program Vietnam 2016, Highlight of PDP VII revised

Table 5: Structure of power sources in percent of total installed capacity

Power Sources	2015	2020	2025	2030
Renewable Energy	5.37 %	9.9 %	12.5 %	21.0 %
Coal	33.45 %	42.7 %	49.3 %	42.6 %
Natural Gas	22.45 %	14.9 %	15.6 %	14.7 %
Hydro	37.31 %	30.1 %	21.1 %	16.9 %
Import	1.42%	2.4 %	1.5 %	1.2 %
Nuclear	-	---	---	3.6 %

Source: GIZ Energy Program Vietnam 2016, Highlight of PDP VII revised

As revealed from the extracted numbers of the revised PDP VII, coal will be the dominant power source with an increase of the installed capacity from 33% in 2015 to 42.6% in 2030, supplying half of the generated electricity by 2030. While natural gas and hydro power will be decreased in capacity and generation over the years, the share of installed capacity of renewable energy will be increased from 5.4% in 2015 to 21% in 2030, adding a share of electricity of 3.7% in 2015 and 10.7% in 2030 to the power mix.

The sub-targets of the specific RE technologies including wind, solar, biomass and hydro are presented in the table below:

Table 6: Sub-targets of renewable energy technologies in MW installed and share of power produced

		2020	2025	2030
Wind	Inst. Capacity (MW)	800	2,000	6,000
	Power produced (%)	0.8	1	2.1
Hydro	Inst. Capacity (MW)	21,600	24,600	27,800
	Power produced (%)	29.5	20.5	15.5
Biomass	Power produced (%)	1	1.2	2.1
Solar	Inst. Capacity (MW)	850	4,000	12,000
	Power produced (%)	0.5	1.6	3.3

Source: GIZ Energy Program Vietnam 2016, Highlight of PDP VII revised

A further policy directive beside the revised PDP VII emphasizing the expansion of RE in Vietnam is Decision No.: 68/QĐ-TTg “Approving Viet Nam’s Renewable Energy Development Strategy up to 2030 with an outlook to 2050” issued by the Prime Minister in November 2015. The decision sets the strategic development objectives of the sector and provides orientation and solutions towards its implementation. On sub-sector level strong emphasis is given to the promotion of biomass energy for electricity and heat generation, setting out high targets for power generation from biomass which differ widely from the targets defined in the revised PDP VII. Explicitly mentioned in the strategy is the use of wood substrates from forest land as feedstock material for energy generation and the necessity of developing and applying sustainability criteria for assessing and regulating sustainable bioenergy projects.

The promotion of power and heat generation from biomass is regulated by Decision No.: 24/ 2014/QĐ-TTg “Support Mechanism for the Development of Biomass Power Projects in Vietnam”, issued by the Prime Minister in March 2014. The regulation is applicable for both single power and combined heat and power systems from biomass and governs (1) the planning and development of biomass power, (2) the incentive mechanism and (3) the implementation arrangements. Responsible for the handling of the decision is the Ministry of Industry and Trade (MoIT) which facilitates and coordinates closely with the relevant authorities on central and provincial level for the implementation.

The following key provisions are made with regard to investment, implementation and operation of biomass power systems:

- As part of the national biomass energy utilization and development master plan the national and provincial biomass power development plan (BPDP) provides the basis for the granting and issuing of the investment certificate for each biomass power plant. The BPDP will be valid for the period 2016–2020 with a vision to 2030. As of April 2016 the BPDP was still under development, expected to be available by the end of 2016. The plan sets out the specific targets for the development of biomass power plants in each province whereby the amount of electricity to be generated from biomass depends on the demand of

electricity as outlined in the national PDP VII, the available biomass resources and the economic, environmental and social benefits attained. During the transitional period each has to seek for special approval subject to the Prime Ministers decision.

- Grid connection for each project is subject to the approved provincial biomass power development plan whereby the seller of power is responsible for the installation of the connection and bears the cost of installation.
- Prior to the implementation of a biomass power plant an investment certificate needs to be granted, which is subject to a signed power purchase and connection agreement, the verification of the system design and other legal requirements.
- The investment certification can be revoked if the investor fails to start implementation of the project 12 months after issuing of the investment license.
- A power purchase agreement (PPA) needs to be signed within 6 months after a request has been issued.
- The power purchaser is obliged to purchase all power produced by the power plant as agreed in the PPA, which has a duration of 20 years.
- The following incentives for biomass power plants are provided: Exemption of import duties for the material and equipment to install the power plant, income tax reduction according to the investment law, land allocation preference by exemption of land use/rental cost, fixed tariff for selling electricity of VND 1,200 equivalent to **USD 0.058 per kWh for CHP plants** with tariff adjustments according to VND/USD exchange rate fluctuations. For biomass power plants other than CHP the tariff will be adjusted annually according to the avoided cost of power generated from imported coal.
- MoIT is in charge of monitoring of the pricing system and may request a change of tariff at Prime Minister level if deemed necessary.

With the circular No.: 44/2015/TT-BCT dated December 2015 issued by MoIT, the Avoided Cost Tariff (ACT) system is in place which regulates the development and pricing/tariff system for power generated by power plants other than CHP plants and bagasse-based extraction-condensing power plants in sugar mills. The ACT will be calculated based on an approved formula set by the MoIT and adjusted annually. The calculation of the ACT is under the responsibility of the Electricity Regulatory Authority of Vietnam (ERAV) which has submitted the ACT for 2016 to the General Directorate of Energy (GDE) in January 2016. With reference to information provided by GDE during the field survey of the analysis, ERAV has submitted the ACT in January 2016 at **USD 0.065** which, from an investors perspective, is being considered as far too low. The low ACT tariff is mainly a result of the currently low cost of coal, which is a key parameter for the calculation of the ACT. The GDE is fully aware that the ACT tariff is not attractive enough to stimulate investment in single biomass power plants and will propose the replacement of the ACT based Feed-in-Tariff (FiT) system by a FiT based instead on the levelized cost of biomass power generation over a defined period of time. Otherwise investment in biomass power plants other than CHP in sugar mills will not be feasible.

The issue of sustainable biomass feedstock supply for biomass power plants is not explicitly addressed on policy level but is rather dealt with on planning level (national/provincial/site) where, by means of selected criteria, the availability of biomass sources needs to be assessed against its potential environmental, social and economic impact of exploitation. Moreover, in compliance with the environmental protection law, an environmental impact assessment and public hearing has to be conducted for each biomass power plant in which the sustainable supply of feedstock needs to be proven.

3 Sustainability certification of solid biomass for bioenergy in Vietnam

3.1 Structure and elements of a certification scheme in general

3.1.1 Key definitions

As presented in the introduction, both government-driven as well as private sector-driven initiatives in the European Union work on sustainability criteria for solid biomass. Sustainable Forest Management (SFM) schemes evolved in the 1990s, with the Forest Stewardship Council (FSC) being one of the first and one of the most popular today. Besides pure forest management certification schemes, bioenergy systems are being developed which include, amongst others, GHG emissions along the whole supply chain. Crop-specific schemes (e.g. for palm oil) are not covered here because they mostly concern crops for the production of liquid biofuels. The following section explains the general structure, elements and actors in a voluntary, market-based certification scheme. Differences between SFM- and bioenergy systems as well as their (potential) implementation in Vietnam are discussed afterwards.

Box 2: Key definitions of certification

- **Standard:** a set of requirements (e.g. principles, criteria and indicators) used as rules and guidelines
- **Verification:** used in general terms to describe any process of testing if a set of requirements has been met
- **Certification:** used in the context of a specific standard for the verification against this set of requirements by an accredited, third party (the certification body)
- **Certification System/ Scheme:** a specific set of requirements (standards) which can be applied e.g. to the production of solid biomass, at forest management level as well as to the subsequent supply chain and use of the biomass
- **Certification Body:** an independent, third party auditor
- **Accreditation:** a mechanism to make sure that the certification body and the certification practices comply with a set of rules. This means that the certification body is both competent and independent such that the results of the certification are reliable and replicable and quality assurance is suitable
- **Accreditation Body:** approves certification bodies

Sources: Nussbaum and Simula 2013; Higman et al. 2013; GFA Certification 2010

In the sustainability certification process, an independent certification body checks the prevalent conditions at a biomass production site or in the biomass supply chain against a determined set of requirements. Those requirements may vary, given that a particular certification system can be structured according to a hierarchy of principles, criteria, and indicators. To ensure the quality and reliability of the certification body's work, the certification body has to be approved by an accreditation body of the respective certification system.

Box 3: Key definitions of certification (continued)

- **Principle:** a self-evident "truth" that serves as the starting point and justification for sustainability assessment
- **Criterion:** a condition or process which clarifies the meaning of a principle but is not yet a direct performance measure
- **Indicator:** provides direct or indirect information of the state and the rate/trend of a criterion, e.g. in form of variables
- **Guidance:** further information for the certification body (and the unit to be certified) to understand the meaning of a criterion in practice
- **Verifier:** data and/or particular threshold values that specifies indicators

Sources: Lähinen et al. 2014; NL Agency 2013; GFA Certification 2010

Due to different core values, the principles and corresponding criteria and indicators may vary for different certification systems in terms of number and focus. The example below illustrates the increasing precision from top (principle) to the bottom (indicators and further explanations).

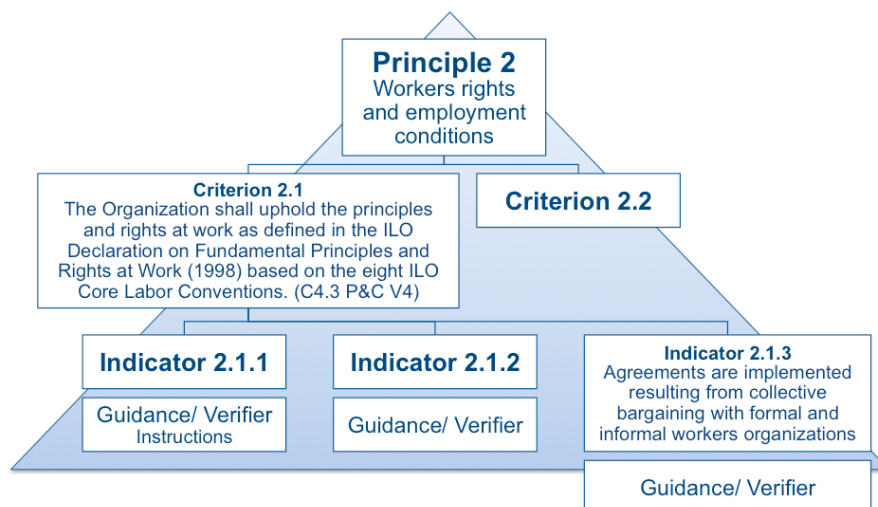


Fig. 2: Hierarchy of Principles, Criteria, Indicators and Guidance/ Verifiers

Source: Own Illustration based on (FSC 2015b)

While forest management (FM) certification comprises processes and conditions at the forest, CoC certification encompasses the steps afterwards. The aim of CoC certification is to trace products from their original source to their final use along the whole supply chain and verify their handling and processing. Legal or physical ownership, or both, changes at different links in the chain. In order to prevent any untruthful claims, audits look at input and output, conversion rates and management systems at each stage of the supply chain. Some schemes also include social and environmental aspects in their CoC standard. A CoC certified supply chain doesn't necessarily have to treat exclusively FM certified material. It is rather a tool for enhancing traceability and preventing the mixing with material from illegal sources. This is important where producers or retailers make claims about the sustainable and/or certified origin of their goods in order to achieve a price premium, for example. The kind of claim they can state is defined by particular labeling rules for each certification scheme. The use of labels and logos is also monitored.

Box 4: Key definitions of certification (continued)

- **Chain of Custody:** the sequence of the product (e.g. solid biomass) from the production site or place of collection to the end client and use (e.g. power plant); a system to trace the way of a product through all links and stages within the supply chain where there is a change of control (legal or physical or both) and to assure its real origin
- **Chain of Custody Certification:** Verification of the traceability in the production and transportation process against certain requirements to prevent the mixing of e.g. certified and uncertified material or to ensure that mixing only happens in the permitted way
- **Segregation:** a mechanism to ensure CoC security by physically separating certified and uncertified materials
- **Identification:** a mechanism to ensure CoC security by marking certified materials
- **Documentation:** a mechanism to ensure CoC security by recording the work processes and instructions to trace the origin of inputs and outputs; all mechanisms aim at preventing the mixing of materials of different origin
- **Labeling Rules:** define which kind of claims about the origin of their products can be made by producers, traders or later actors in the supply chain

Sources: Higman et al. 2013; Goh and Junginger 2011

3.1.2 Chain of custody models

There are different ways to follow the journey of the product, from the solid biomass, to the final step of power generation. In general, the following four models of chain of custody are used in the context of certification: 1) identity preservation, 2) product segregation, 3) mass balance and 4) book and claim. The most exact way for tracing material is the **identity preservation** system, where it is possible to identify the original source of the certified product, e.g. the specific forest plantation. The **production segregation** system ensures complete supply from certified sources, although the end product cannot be assigned to the individual plantation anymore (ISEAL 2013).

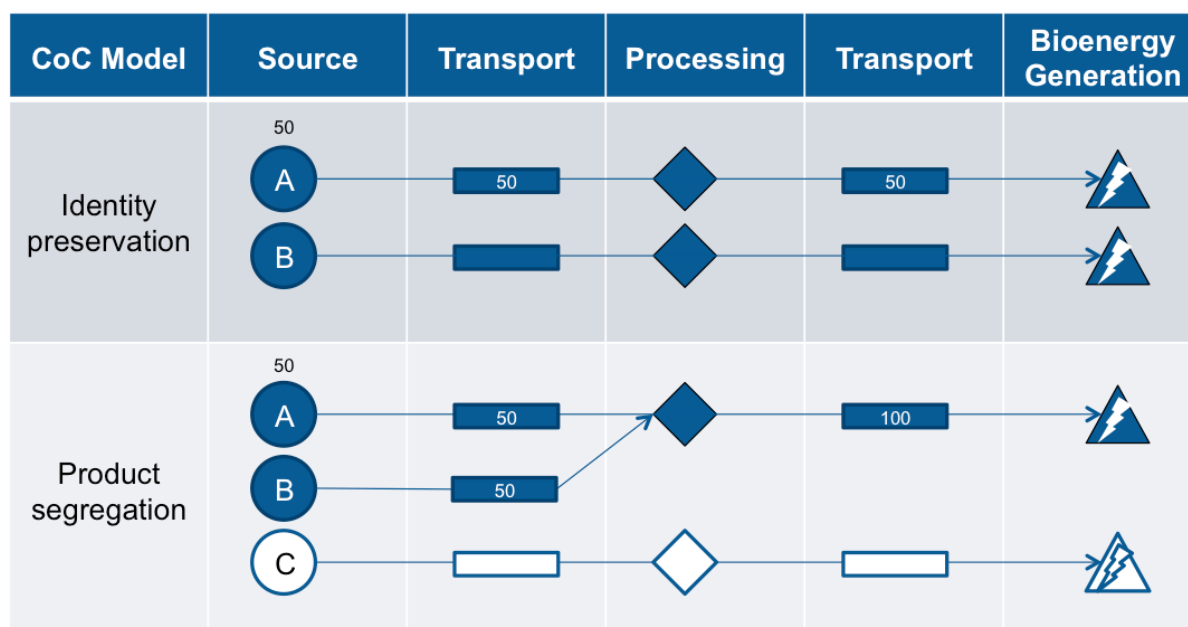


Fig. 3: Chain of custody models - Identity preservation, Product segregation

Source: Own Illustration (blue = certified; white = uncertified; example figures without assuming any processing conversion factor) according to ISEAL 2013; NL Agency 2013

The **mass balance model** is used especially when it is not feasible to keep certified and uncertified material separately. This is the case when there is not enough supply of certified material, the linkages between supply chains are not sound, or the physical characteristics of the product impede segregation. Here, the mixing of certified and uncertified volumes is allowed as long as there are “checks and balances”, i.e. safeguard mechanisms so that the input of certified material equals the claimed output (ISEAL 2013). Depending on the type of chain of custody, the wording used for marketing varies. If the mass balance system is used, the final product “contains x%” of certified ingredients, which is a percentage based claim (Higman et al. 2013). Models 1-3 physically trace the material, whereas model 4, the **book and claim** approach, decouples the physical trade in commodities from the trade of sustainability certificates, similar to the trade of green electricity certificates (NL Agency 2013). Via a trading platform, the producer sells sustainability certificates to the retailer, who can be located anywhere else. Hence, the final product does not really contain certified material from this source. Yet, especially in emerging certification sectors, the trade of certificates can be an incentive for sustainable production. Using the book and claim system, the claim states that the product only “supports” certification. When it comes to choosing the adequate chain of custody model, one should keep in mind that every model has its advantages and disadvantages. Therefore, to opt for one model means a certain tradeoff between the thoroughness of verification and how accessible and efficient this process can be. Eventually, the “right” model depends on characteristics of the product, real conditions and the specific risks in the supply chain (ISEAL 2013).

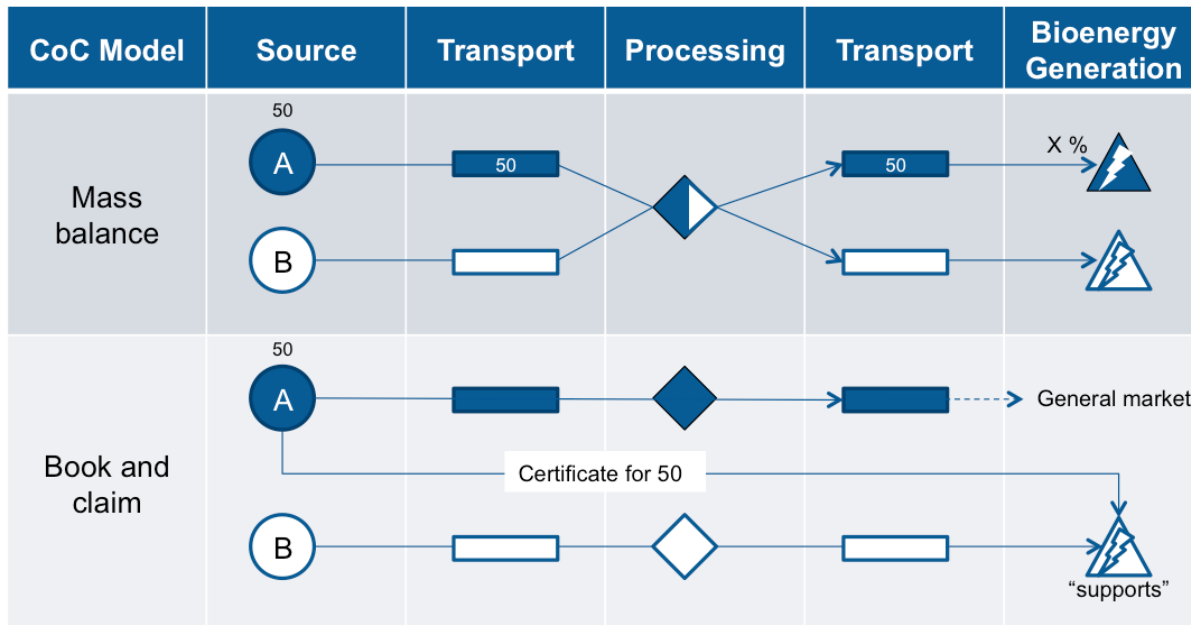


Fig. 4: Chain of custody models - Mass balance, Book and claim

Source: Own Illustration (blue = certified; white = uncertified; example figures without assuming any processing conversion factor) according to ISEAL 2013; NL Agency 2013

3.1.3 Steps towards certification

In order to get FM or CoC certification, the first step is to choose an adequate certification system and then to contact one of its certification bodies. Some of the agents already active in Vietnam as well as alternative schemes for bioenergy certification are presented below. The first contact with a certification body serves on the one hand for being informed about the current standard and overall certification procedure. On the other hand the certification body makes a quotation, based on the information gathered from the entity that wishes to receive a certificate, the “candidate” (Cota Gomes et al. 2002). A contract will define responsibilities of the parties involved, costs, necessary activities and related deadlines. After the contract has been signed, preparations start for the pre-audit and stakeholder interviews (in case of a FM certification) or already for the main audit (in case of a CoC certification).

An audit is a field assessment carried out by an auditor sent by the certification body. It aims at verifying the given conditions against the specific certification system’s requirements. Based on the field assessment, an audit report including pre-conditions, conditions and recommendations is prepared and revised by independent experts (in the case of FM certification). Pre-conditions may refer to required improvements that have to happen before the entity can be certified, while conditions can be implemented during a given period of time. Recommendations by contrast are not mandatory but refer to suggested improvements. Nevertheless, the objective is constant development, i.e. that those recommendations should not be neglected (Cota Gomes et al. 2002). If the audit report states that the candidate fulfills the required pre-conditions and complies with the standard, i.e. the necessary conditions for a positive decision for certification, the certification body issues the FM or CoC certificate. A certificate is valid only for a certain timeframe. Surveillance audits take place to check if the certified entity implemented the required conditions and maintains the standard. These surveillance audits may take place on an annual basis. Although the duration of the certification process depends on the individual realities and capacities of each company, a CoC certificate can generally be issued within a couple of weeks or up to a few months, while the certification process for a FM certificate is a matter of several months or may even exceed one year.

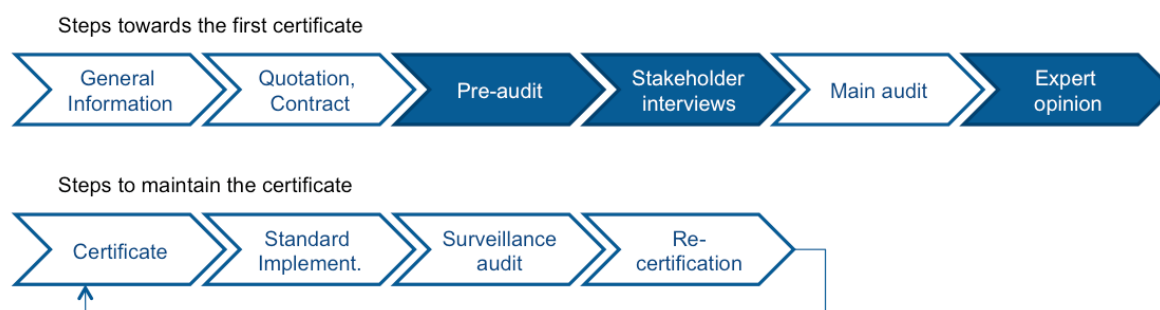


Fig. 5: Steps towards certification

Source: Own Illustration (blue = only FM; white = both FM and CoC; note that the audit for FM certification is not the same as for CoC certification) according to GFA Certification 2016; Cota Gomes et al. 2002

3.2 Overview of selected solid biomass certification systems in Vietnam

Sustainable feedstock supply can be enhanced through different certification systems. Not all of them cover the whole supply chain from cultivation to energy production. SFM schemes basically certify management activities at the production forests although their CoC standards can be used for monitoring the subsequent steps along the supply chain. The broader approach of recently emerging bioenergy systems also takes into account the GHG emissions throughout the production process of wood substrates.

While in Europe and North America vast forest areas are already certified against SFM standards, the challenge in tropical regions is to establish organized forest management and enabling conditions for certification (Burger, Hess, and Lang 2005). Sustainable and responsible forest management not only aims at preserving forests' biodiversity and physical properties. It also requires a certain way of extracting forest resources, including protection measures, such that future generations are still able to benefit from the ecological, social, cultural, and economic functions of forests (MacDicken et al. 2015; GFA Certification 2010). At the moment, FSC is the dominant SFM certification scheme in Vietnam. Another globally present system, the Programme for the Endorsement of Forest Certification schemes (PEFC) recently started cooperation with the Vietnamese government to develop a Vietnamese national standard for SFM: the Vietnam Forest Certification Scheme (VFCS). Facing international negotiations for the AFTA free trade agreement or the VPA-FLEGT, sustainability certification in the forestry and especially in the USD 7 billion wood-processing sector becomes more relevant for Vietnam (MARD 2016). The target is to reach 500,000 ha under SFM by 2020 with a significant share of natural forests and smallholder forests (PEFC 2016c). The Vietnamese government supports applications for internationally recognized certification (like FSC, PEFC) through two mechanisms: (1) by direct financial support, granting VND 100,000 per ha after successfully obtaining sustainability certification; and (2) via indirectly encouraging the market development of voluntary certification schemes, especially in the furniture industry. This concerns enabling conditions in order that furniture companies can support their suppliers in becoming certified, for example, with the provision of good species or technical advice (MARD 2016).

Table 7: FSC and PEFC Certificates Worldwide

	FSC		PEFC
Forest management (FM) certificates and certified forest area	1,368	FM/CoC	certificates > 750,000 forest owners
	187 M ha		275 M ha
Chain of Custody (CoC) certificates	30,356		17,605
As of	April 2016		March 2016

Sources: FSC 2016; PEFC 2016

3.2.1 Forest Stewardship Council (FSC)

FSC International develops the FSC standard (principles and criteria) according to ISEAL Alliance requirements that outline general characteristics of a good standard. ISEAL is a membership association aiming at improving impact, credibility, progress, and effectiveness of standards. Its work is based on and complementary to the International Organization for Standardization (ISO) (ISEAL 2016). Within the FSC framework, three different types of certification exist: (1) Forest Management certification (FM), (2) Chain of Custody (CoC) certification and (3) Controlled Wood (CW). The difference between FM and CoC certification was outlined above: FM certification applies to the Forest Management Units (FMU), whereas CoC certification targets processors, manufacturers,

and retailers of FSC certified products (FSC 2016c). Regarding the FSC framework, there is only one accreditation body, Accreditation Services International (ASI) that approves the certification bodies. In Vietnam, it is possible that the certification body offers both consultant services and conducts the audit of the forest operation or other actors in the supply chain (BIFA 2016).

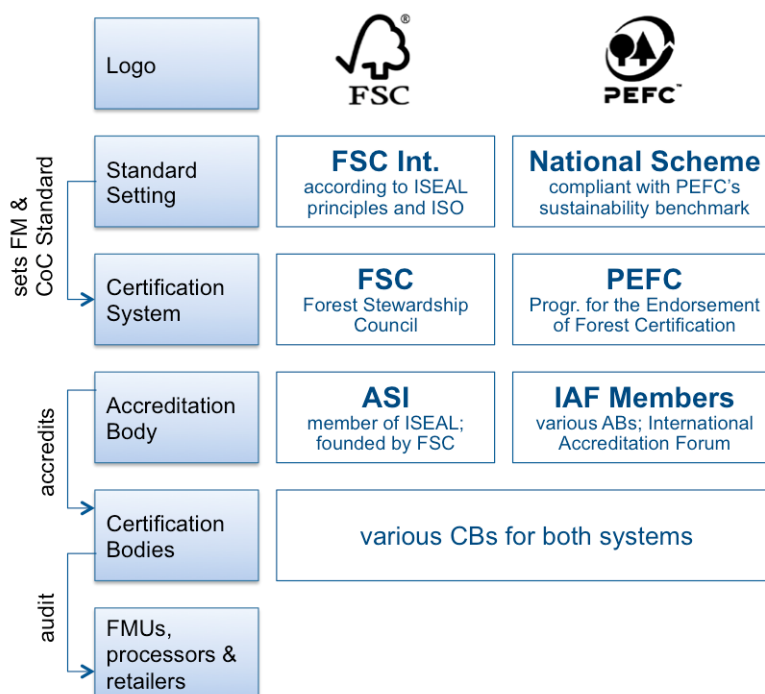


Fig. 6: Simplified overview of relations between elements of a certification system

Source: Own Illustration according to FSC International 2016; Nussbaum and Simula 2013; Laity et al. unpublished

The regional office of FSC Asia Pacific is located in Hong Kong. At the moment, there is no office in Vietnam, but the Research Institute for Sustainable Forest Management and Forest Certification (SFMI) in Hanoi acts as a subdivision of FSC. Its functions comprise, amongst others, the preparation of studies on SFM, forest planning, tropical silviculture, and forest product procession and marketing. Another task is technical support and capacity building for SFM. The SFMI also runs field surveys and is working on the national criteria for SFM and FSC FM certification. For operating in Vietnam, a certification body has to apply for accreditation for each country individually. SFMI may give recommendations of the certification body to FSC, resp. ASI. At the moment, about 33 certification bodies run FSC audits worldwide. In Vietnam, the following companies conduct audits for FSC and, partly, PEFC certification (SFMI 2016):

Box 5: Operating certification bodies in Vietnam

- CU Control Union Certification (Netherlands)
- GFA Certification (Germany)
- Rainforest Alliance/ Smartwood (USA)
- SA Woodmark (Britain)
- SGS (South Africa)
- Bureau Veritas (France)

Source: SFMI 2016

3.2.1.1 FSC forest management certification

FM certificates are valid for a time period of five years with annual surveillance audits (FSC 2016e). The general FSC principles and criteria were revised in 2015 (FSC-STD-01-001 V5-2 EN).

Box 6: FSC Principles

- Principle 1: Compliance with Laws
- Principle 2: Workers' Rights and Employment Conditions
- Principle 3: Indigenous Peoples' Rights
- Principle 4: Community Relations
- Principle 5: Benefits from the Forest
- Principle 6: Environmental Values and Impacts
- Principle 7: Management Planning
- Principle 8: Monitoring and Assessment
- Principle 9: High Conservation Values
- Principle 10: Implementation of Management Activities

Source: FSC International 2016

Principles and criteria are generic and are valid at a global level; indicators are country specific. Hence, the principles with corresponding criteria can only be applied for verification if they are complemented with an approved set of indicators, individually adapted to the national, regional or local conditions (FSC 2015a). For example in Vietnam, conditions are different than in Europe. In Vietnam, a big proportion of forests are managed by small households with low investment capacity. They do not use sophisticated machinery for harvesting but instead use buffaloes or rivers for transportation. Furthermore, wood species in Vietnam have different growth conditions and different rotation periods (SFMI 2016). A three-chambered working group (environment, economy, social issues) around the SFMI is currently developing the national standard, including context specific indicators. The national standard shall be submitted to FSC International mid-2016 and then enter into a pilot testing phase (ForCES 2016). Meanwhile, certification bodies use an interim FSC FM standard. At the same time, a FSC project presently develops a set of International Generic Indicators (IGIs), which will complete the FSC principles and criteria so that the standard can be used in regions where there is no national standard yet. The 2015 version of the IGIs (FSC-STD-60-004 V1-0 EN) can be applied to both natural forests and plantations (FSC 2015b). The certification of plantations plays a crucial role in Vietnam due to the present proliferation of wood chips plantations. Fast growth rates of species planted at plantations as well as a more consistent quality both support high and efficient production of timber, wood chips and other materials. On the one hand, this reduces pressure on natural forests. On the other hand, plantations are not suitable to replace natural forests, particularly in terms of environmental services and biodiversity. Especially the conversion of natural forest to plantation area entails social and ecological problems (FSC 2014).

While a comprehensive standard that takes the special conditions and requirements of plantations into account is beneficial from an environmental and social perspective it could also increase the burden and costs of certification, as well as the complexity for smallholders (Laity et al. unpublished). To enable access to those more vulnerable groups, an adapted Small and/or Low Intensity Managed Forest (SLIMF) Certification exists. It applies for small FMUs who manage less than 100 ha or fulfill determined criteria, such as harvesting exclusively non-timber forest products (NTFP). The SLIMF certification reduces the burden for smallholders by a lighter set of requirements (FSC 2016d). In Vietnam, the SFMI supports small forest owners by conducting a kind of “pre-evaluation” of the forest area. For this, the smallholders ask for appraisal at the SFMI. If the operation seems to be suitable for certification, SFMI establishes contact between the forest owner(s) and a certification body (SFMI 2016).

3.2.1.2 FSC chain of custody certification

FSC comprises three types of CoC certification: (1) individual CoC certification, (2) multiple site CoC certification and (3) project certification. The first one is a standard for individual companies that simultaneously produce and trade FSC FM certified products (FSC-STD-40-004). The second standard serves for group certification of several small enterprises but can, under certain conditions, also be applied to some larger companies with multiple operations in order to benefit from economies of scale. The last one concerns single objects such as buildings where FSC certified wood or woody post-consumer reclaimed material is used (FSC 2016e).

3.2.1.3 FSC Controlled Wood

Compared to sustainability certification, FSC CW only serves for excluding wood from unacceptable sources but does not consider sustainability issues. Based on five categories, this concerns woody biomass that was harvested

- illegally
- in violation of traditional and human rights
- in forests in which areas that are especially worth of protection (HCV) are threatened by management practices

- in forests being converted to plantations or non-forest use
- in forests in which genetically modified trees are planted.

Controlled wood comprises both the forest management and the chain of custody level (FSC 2016e). CW material can be used for producing “FSC mix” goods and therefore allows managing fluctuating supply of FSC certified material. Larger companies use this verification approach for their B2B trade, but governments also require similar due diligence, as can be observed from the examples of South Korea and Japan for wood chips originating from Vietnam (SGS Vietnam 2016). FSC and network partners such as Rainforest Alliance and NEPcon carry out Controlled Wood national risk assessments. So far, 20 countries have been assessed. Vietnam is not among the assessed countries but a priority country, meaning that the risk assessment is expected to be completed by the end of 2017 (FSC 2016c).

3.2.1.4 FSC certificates in Vietnam

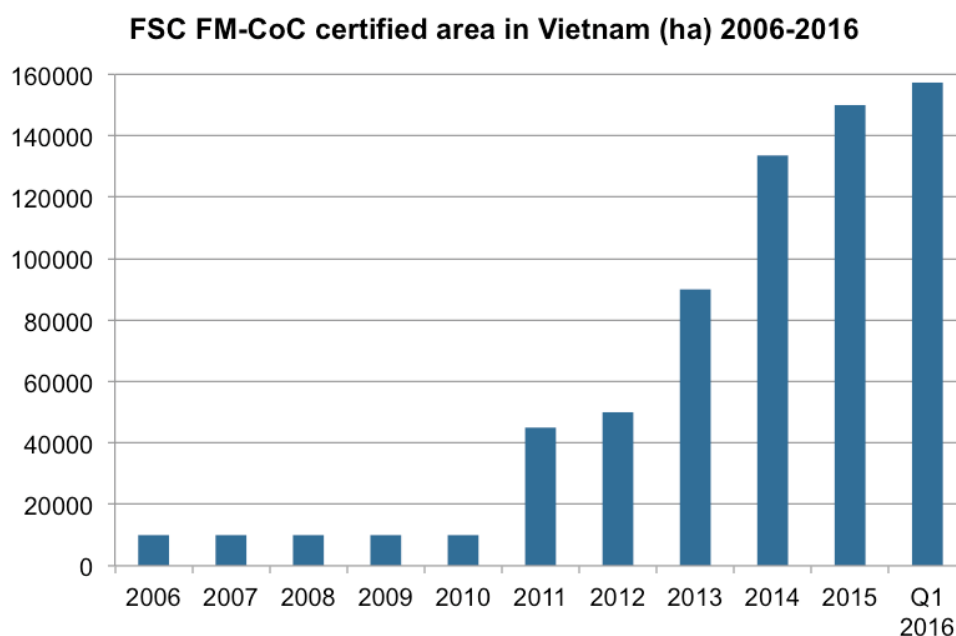


Fig. 7: Overview of total amount of FSC FM-CoC certified forest area in Vietnam (ha) 2006-2016, without CW

Source: Own Illustration according to FSC 2016a; Laity et al. unpublished

In Vietnam, FSC certification is mainly used to gain market access, e.g. to Europe or the U.S. Therefore, most of the certified products are timber and saw logs used in the later stages of the manufacturing process of outdoor furniture (Laity 2016). Due to the international policy trend towards timber legality, SFM and sustainability certification awareness is also increasing for those topics in Vietnam, at least with companies that are producing for export. However, there is not enough capacity for FSC timber and other wood material sourced in Vietnam to meet the rising demand (Woodland JSC 2016). Besides higher quality timber for the furniture industry, demand for wood chips in the region, such as for bioenergy/ co-firing in South Korea, is also high. As of July 2016, the total FSC FM certified forest area amounts to more than 158,400 ha, where these certified companies simultaneously hold a CoC certificate (FSC 2016, certificate database; excluding Controlled Wood area). To foster supply of certified material from Vietnam, the expansion of certification is needed. Even though there is a logging ban into natural forests, two larger FMUs with FSC FM certificate are exempt from the ban (Decision No. 2242/QĐ-TTg), namely Dak To forestry in Kon Tum province and Truong Son Forestry, member of Long Dai Forestry Industry in Quang Binh province (ETTF 2016). Consequently, the ban does not apply to an area of 47,238.6 ha of natural forest. The exception shall also apply to affected certified smallholder groups. Due to the logging ban, the “growth” potential lies in plantations. Yet, small households manage plantations that encompass less than 100 ha (WWF Greater Mekong 2016). Smallholders manage about half of the country’s plantations (PEFC 2015c; GIZ Vietnam 2015). For that, low investment capacities of smallholders are reflected in the small portion of certified areas owned by SLIMFT groups. Currently, smallholder groups manage about 2,245 ha, i.e. less than 15% of the total certified forest area (including natural forests and plantations). The majority of certified plantations are managed by state-owned enterprises.

Table 8: FSC FM-CoC certified area in Vietnam (ha)

Name	Cert. Area (ha)	Species	Location
(1) Quang Tri household cluster (smallholder group)	1,392.39	Acacia	Quang Tri province
(2) WB3 - Forest Sector Development Project (smallholder group)	851.73	Acacia, Eucalyptus	Thua Thien Hue, Quang Nam, Quang Ngai & Binh Dinh provinces
(3) Forest Products Export Joint Stock Company of Quang Nam	1,475.46	Acacia	Quang Nam province
(4) Ben Hai Forestry Company	9,463	Acacia, Pine	Quang Tri province
(5) Binh Nam Company Limited	2,969.19	Acacia, Eucalyptus	Binh Dinh province
(6) VINAFOR	35,268.73	Acacia, Eucalyptus, Pine, Teak	Hoa Binh, Quang Ngai, Dong Nai & Gia Lai provinces
(7) Dak To forestry (DAKTOPLANCO)	15,755.4	Aglaia, Others	Kon Tum province
(8) Truong Son Forest Management Enterprise/ Long Dai Forestry Industry Company Limited	31,483.2	Aglaia, Others	Quang Binh province
(9) Dai Thanh Investment and Development Limited Company	17,575.4	Others	Dak Nong province
(10) Duong 9 Forestry One member Ltd. Co.	4,868.4	Acacia, Pine, Rubber	Quang Tri province
(11) Trieu Hai Forestry Company	5,227.82	Acacia, Pine	Quang Tri province
(12) Uong Bi Forestry Company One Member Ltd. Co	5,178.9	Acacia, Eucalyptus, Pine	Quang Ninh province
(13) Quy Nhon Plantation Forest Company of Vietnam Ltd (QPFL)	9,762.61	Acacia, Eucalyptus	Binh Dinh province
(14) Viet Nam Paper Corporation (VINAPACO)	16,118.98	Acacia, Eucalyptus	6 forest companies in Phu Tho province, 2 companies in Ha Giang province
(15) Thuy Son Joint Stock Company	1,047.96	Acacia	Ca Mau province
Total	158,439.17		



As of July 2016, including plantations and natural forests, as well as protection areas; Sources: Department of Forest Production Management October 2015 (VNForest homepage), FSC International 2016 (database)

FSC FM areas that have been certified since the second half of 2015 are mainly plantations for round-wood and fuel wood production, including wood chips and wood pellets. Out of the total area of around 158,400 ha certified forest (FM), at least 78,500 ha are plantation forests, and at least 13,000 ha serve for protection purposes.³ According to the Ministry of Agriculture and Rural Development, the proportion of natural forests (not for production) is about 50% of the total certified area of ca. 169,000 ha, including one CW certified company (MARD 2016). Given an estimated 13.9 M ha of gazetted forests in Vietnam (GIZ Vietnam

³ Summing up information where the forest type is clearly defined.

2015), the total certified area is just a bit over 1% of the total cover – only a small proportion in relation to the target of 500,000 ha by 2020.

Although not much FSC certified material originates from Vietnamese (plantation) forests, various Vietnamese enterprises hold a CoC certificate for FSC 100%, FSC Mix or FSC CW. Imported wood originates from various countries, such as Brazil, Europe or the U.S., and this can include FSC certified material. For CoC certification, more certification bodies than the ones mentioned above can be found in Vietnam, like TÜV Süd. As of April 2016, there are 481 FSC CoC certificates in Vietnam (FSC 2016a), including a variety of industries such as pulp and paper, printing, NTFPs and furniture, at a variety of stages within their supply chains. Given the data in April 2016, the category “wood in chips or particles”, including wood chips and wood pellets, counts more than 135 CoC certificates in Vietnam (FSC 2016b).

Further information about FSC certified companies is available online:

- FSC database www.info.fsc.org
- Marketplace⁴ <https://marketplace.fsc.org/>

3.2.1.5 Global Forest and Trade Network (GFTN)

The World Bank-WWF Alliance for Forest Conservation and Sustainable Use does not directly support individual forest certification but instead fosters enabling conditions, raises awareness about issues like illegal logging and promotes forest trade networks. Initiated by WWF Greater Mekong, the Global Forest and Trade Network (GFTN) enables FSC certification for small households in a stepwise group certification approach. It additionally facilitates trade links between actors in producer and consumer countries to achieve the target of eliminating illegal logging and improving forest management (Higman et al. 2013).

3.2.2 Programme for the Endorsement of Forest Certification (PEFC) & Vietnam Forest Certification Scheme (VFCS)

3.2.2.1 PEFC forest management certification

In comparison to FSC, PEFC does not use interim standards but works with an own national scheme per country. By this “bottom up approach”, ownership is transferred to the national level. National accreditation bodies, being members of the International Accreditation Forum (IAF), govern the individual national certification systems. PEFC International Standard (PEFC ST 1003:2010) serves as a benchmark for national certification schemes and includes seven criteria, similar to FSC’s principles. The document also provides guidelines for the interpretation of requirements for the application to plantation forestry (PEFC 2010).

Box 7: PEFC Criteria

- Criterion 1: Maintenance appropriate enhancement of forest resources and their contribution to the global carbon cycle
- Criterion 2: Maintenance of forest ecosystem health and vitality
- Criterion 3: Maintenance & encouragement of productive functions of forests (wood and non-wood)
- Criterion 4: Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems
- Criterion 5: Maintenance & appropriate enhancement of protective functions in forest management (soil and water)
- Criterion 6: Maintenance of other socio-economic functions and conditions
- Criterion 7: Compliance with legal requirements

Source: PEFC 2010

In the Southeast Asian region, PEFC already endorsed some national certification schemes. For instance, the Malaysian Timber Certification Council (MTCC) developed the Malaysian Timber Certification Scheme (MTCS), which was approved in 2009 and renewed in 2014, and brought forth 3,892,872 ha of certified forest area and 357 CoC certificates (as of March 2016, PEFC).

PEFC’s activities in Vietnam comprise four focal points, namely the development of a national scheme, building of cooperative alliances, expansion of pilot projects, and the development of a Group CoC and FM standard. The latter activity includes the

⁴ Still in pilot testing phase and not available in every country.

thorough testing of Circular 38. PEFC aims at reducing complexity for smallholders whereas FSC requirements are high in order to secure high sustainability standards. Two initiatives in the region promote smallholder certification through awareness rising, capacity building, international cooperation and experience exchange: “The Asia Promotions Initiative” and the “Expanding Group Certification Globally” program. In addition, PEFC together with Hue University has a project with cooperative alliances in the provinces Thua Thien Hue, Quang Tri and Quang Ngai (Laity et al. unpublished). In Vietnam, between 2,000-3,000 ha are being prepared for acquiring PEFC group FM certification – just waiting for the national scheme to be endorsed (PEFC 2015c).

3.2.2.2 PEFC chain of custody certification

The 2015 edition of the PEFC International Standard (PEFC ST 2002:2013) outlines requirements for the CoC certification for forest-based products, and regulates the following (PEFC 2015a):

- Identification of the material category of products
- Minimum Due Diligence System (DDS) requirements
- Chain of custody method
- Sale and communication on claimed products
- Minimum management system requirements
- Social, health and safety requirements in chain of custody

Two CoC models are mainly used within the PEFC framework: the “percentage based method” and the “physical separation method”. The first one allows for combining certified with uncertified material as long as the percentage of certified raw material is known and made public to the customers (average percentage) or as long as the enterprise sells the corresponding proportion of used certified input (volume credit). This mechanism is similar to the mass balance CoC model. The second method physically segregates certified and non-certified inputs throughout the whole value chain (PEFC 2016b).

Comparable to the FSC Controlled Wood approach, PEFC incorporates a mandatory safeguard for CoC for avoiding the mixing with illegally and controversially sourced wood. Unacceptable wood is therefore material that does not comply with regulations regarding (PEFC 2016b):

- Forestry operations and harvesting, including conversion of forest to other uses
- Management of areas with high environmental and cultural values
- Protected and endangered species
- Health and labor issues relating to forest workers
- Property, tenure and use rights of indigenous peoples
- Payment of taxes and royalties
- Areas utilizing genetically modified organisms.

As of April 2016, nine valid PEFC CoC certificates can be found in Vietnam via the PEFC’s database. Certified companies cover household and sanitary paper, packaging, printing and the furniture sector. Certification bodies operating in Vietnam are among others the Bureau Veritas (BV), NEPcon, Scientific Certification Systems (SCS), and Société Générale de Surveillance SA (SGS) (PEFC 2016a). Compared with issued FSC CoC certificates this number is quite low. In order to develop PEFC CoC certification in Vietnam, PEFC started cooperation with the Handicraft & Wood Association of Ho Chi Minh City (HAWA) (PEFC 2015b).

3.2.2.3 Steps towards the VFCS

With the approval of Decision 83 by MARD, the Vietnamese government started a program for an own Vietnamese FM certification that shall be recognized by PEFC: the VFCS (PEFC 2016c). This goes hand in hand with a policy shift from wood chips production to longer rotation periods and, hence, timber production of higher quality that is suitable for furniture manufacturing and export. Furthermore, it is linked to the Vietnamese Forestry Development Strategy 2006-2020 and the Forest Sector Reform. Previous efforts for voluntary mechanisms will be scaled up and accelerated by the national scheme. Malaysia’s experience with a national sustainability certification system, the Malaysian Timber Certification Council (MTCC), can serve as an example in the region to learn from. If challenges like capacity building, framework design, or resource allocation are overcome, the VFCS can be a cost effective way towards certification in Vietnam (GIZ Vietnam 2016). It is crucial to develop requirements for a reliable monitoring, evaluation and auditing system. A SFM roadmap was proposed to the Prime Minister in January 2016 (MARD 2016). Key partner in the project is the Vietnam Academy of Forest Science (VAFS) where about 700 people in 16 regional offices provide e.g. technical support for SFM (PEFC 2016c). The ambitious aim is the endorsement of VFCS by the end of 2016 (MARD 2016).

Box 8: Main objectives of the VFCS

- Development and operation of requirements of forest certification
- Development of national standards, policies and toolkits for implementation of forest certification
- Quality control of forest certification implementation
- Capacity building and awareness raising of stakeholders

Source: Laity et al. unpublished

3.2.3 Other solid biomass sustainability certification systems and initiatives**3.2.3.1 International Tropical Timber Organization (ITTO)**

Since 2015, Vietnam is a producing member of the International Tropical Timber Organization (ITTO) under the International Tropical Timber Agreement (ITTA) of 2006 (SFMI 2016; ITTO 2016). ITTO aims at assisting member countries in the management and conservation of their tropical timber resources. ITTO's action program therefore promotes SFM practices (among others reduced impact logging, community forestry, biodiversity and trans-boundary conservation). The updated Voluntary guidelines and suggested actions for SFM encompass seven principles on the following aspects: (1) forest governance and security of tenure, (2) land use planning, the permanent forest estate and forest management planning, (3) ecological resilience, forest health and climate change adaptation, (4) multipurpose forest management, (5) silviculture management, (6) social values, community involvement and forest-worker health and safety, and (7) investment in natural forest management and economic instruments (ITTO 2015). However, those are voluntary principles and ITTO neither appoints any accreditation nor certification bodies who would perform audits (SFMI 2016).

So far, only forest management certification systems have been discussed. This is because, at the moment, only FSC is present in Vietnam. Nonetheless, PEFC has already started the development of a national standard. In addition, bioenergy systems like the Sustainable Biomass Partnership (SBP) are preparing their breakthrough in the country. Bioenergy schemes pursue a broader approach and take the whole value chain into account.

3.2.3.2 Sustainable Biomass Partnership (SBP)

Because of potential effects of a biomass sustainability standard on the European internal market, private sector initiatives became active (EC 2014). Members of the SBP are utilities like DONG energy, Drax, E.ON, ENGIE, HOFOR, RWE, and Vattenfall (SBP 2016). Succeeding the Initiative Wood Pellet Buyers (IWPB), SBP is a certification system especially designed for wood substrates, like wood chips and wood pellets, for industrial scale energy production. Its objective is to verify the legal and sustainable origin of woody biomass. For this purpose, SBP recognizes established and internationally renowned SFM certification systems like PEFC and FSC. In addition, the SBP scheme complements the verification process with key requirements of biomass users. SBP's framework comprises six standards with principles, criteria and indicators, or specified requirements and processes.

Box 9: SBP Standards

- Standard 1: Feedstock compliance standard
- Standard 2: Verification of SBP-compliant feedstock
- Standard 3: Requirements for certification bodies
- Standard 4: Chain of custody
- Standard 5: Data collection and communication
- Standard 6: Energy and carbon balance calculation

Source: SBP 2016

SBP Framework version 1.0 was launched in March 2015. In September 2015, the first two certification bodies were approved: NEPCon with a worldwide focus, and NSF International with specialization on Canada and USA. By April 2016, already 18 certificates had been issued, amongst others in the Baltic States, Poland, Portugal, USA, and Denmark (SBP 2016). Further certification bodies are participating in the process of accreditation. It is likely that SBP will expand its activities to Southeast Asia in the near future (SGS Vietnam 2016).

Table 9: SBP Framework - Example Principle, Criterion, Indicator & Guidance for Standard 1

Standard 1: Feedstock Compliance Standard	
Principle 1	Biomass feedstock is legally sourced
Criterion 1.1	The Supply Base is defined
Indicator 1.1.1 (normative)	<p>The BP Supply Base is defined and mapped</p> <p>Examples of means of verification:</p> <ul style="list-style-type: none"> - Geographic and other boundaries to the Supply Base are defined and justified - Maps to the appropriate scale are available - Key personnel demonstrate an understanding of the Supply Base
Guidance (not normative)	<p>The description of the Supply Base and accompanying maps should be appropriate to its size and any variation within it. Complex supply chains may require additional definition.</p> <p>The requirement relates to feedstock included in the SBE. Certain feedstocks from outside the SB may be used in SBP certified biomass so long as they meet all requirements (see CoC Standard)</p>
Principle 2	Biomass feedstock is sustainably sourced

Source: SBP 2016

3.2.3.3 “Better Biomass” - NTA 8080

The Better Biomass, or NTA 8080, certification system covers the whole value chain beginning at the biomass production and ending with the energy generation. Its basis are the “Netherlands Technical Agreement 8080 (NTA 8080): Sustainability criteria for biomass for energy purposes” and the “Netherlands Technical Agreement 8081 (NTA 8081): Certification scheme for sustainably produced biomass for energy purposes” (NL Agency 2013) that were developed in a multi-stakeholder consensus process. Solid, liquid, as well as gaseous biomass can be certified against this standard (BetterBiomass 2016). The Standard comprises nine principles and includes a CoC set of requirements.

Box 10: Better Biomass/ NTA8080 Principles

- Principle 1: The greenhouse gas balance of the production chain and the application of the biomass is positive
- Principle 2: Biomass production is not at the expense of important carbon sinks in the vegetation and in the soil
- Principle 3: The production of biomass for energy shall not endanger the food supply and local biomass applications (energy supply, medicines, building materials)
- Principle 4: Biomass production does not affect protected or vulnerable biodiversity and will, where possible, strengthen biodiversity
- Principle 5: In the production and conversion of biomass, the soil and soil quality are retained or even improved
- Principle 6: In the production and conversion of biomass, ground and surface water are not depleted and the water quality is maintained or improved
- Principle 7: In the production and conversion of biomass, the air quality is maintained or improved
- Principle 8: The production of biomass contributes to local prosperity
- Principle 9: The production of biomass contributes towards the social well-being of the employees and the local population

Source: NL Agency 2013

In April 2016, more than 60 certificates have been issued in the Netherlands, Germany, and Great Britain. Of these, ten certificate holders handle wood chips, one certificate holder handles wood pellets, one uses both wood chips and pellets, and four certificates were issued in the wooden residuals area. The certified enterprises are all located in the Netherlands except of one British company (BetterBiomass 2016). Albeit there is no NTA 8080 certificate listed in Vietnam, a pilot project led by Eneco tested the practicability of the certification system under Vietnamese conditions (Eneco 2013). Starting point was the supposed enormous potential of wood waste generated in the furniture industry in Vietnam. The aim of the project was to collect and pelletize wood waste for the export to the Netherlands and using them there for green energy production. Constraints were given by the requirement that the pellets had to be produced in a verifiable sustainable manner. Project partners were e.g. IKEA and the Dutch certification body Control Union. The reception of the project by the Vietnamese government was positive: the Industrial Zone (Nam Tan Uyen) supported the project

in obtaining licenses, permits, and infrastructure. Also raw material suppliers (furniture manufacturers) were interested in the project but felt that it was progressing too slowly. For them, added value is attached especially to the sale of residues. Moreover, the project triggered a process of re-thinking the use of residues amongst suppliers. Some key findings of the final report show that the major part of FSC certificated wood has to be imported because national resources cannot meet demand; that certification of the project against NTA 8080 standard is possible if less sustainability criteria apply due to the project's realities; and that still the financial viability is not given. Eneco concluded that "it was not economic feasible to import the biomass from Vietnam to the Netherlands" at least at that given moment. Reasons may be found in the dependence of renewable energy from biomass on subsidy levels and time period, the delay of investment decisions, and in the transportation costs (Eneco 2013).

3.2.3.4 International Sustainability & Carbon Certification (ISCC)

The International Sustainability & Carbon Certification (ISCC) systems aims at

- reducing Greenhouse gas emissions
- preventing biomass production on land with high biodiversity and high carbon stock
- applying good agricultural practices and the protection of soil, water and air, and
- respecting human, labor and land rights.

ISCC-EU standard satisfies sustainability requirements for biofuels set by the European Commission as outlined in the introductory section of the subsector analysis. Likewise, ISCC-DE is used for checking against compliance requirements with the German biofuel regulations of the German Sustainability Ordinances (BioNachV). In contrast, ISCC-Plus encompasses biomass operations in the food, feed, chemistry, bioplastics sector as well as solid biomass. Since 2010 until today, over 10,000 certificates in all covered industrial sectors have been issued. ISCC spans its geographical scope over approx. 100 countries (ISCC 2016). ISCC certificates for wood energy can be found e.g. in Finland but not yet in emerging and developing countries. Nevertheless, the implementation of this certification is possible in general. ISCC has experience in chain of custody certification in Asia, ranging from smallholders to larger corporations (ISCC Germany 2015).

3.2.3.5 Green Gold Label (GGL)

Established in 2002, the GGL focuses on the market segments of "Biomass for the production of biobased chemicals and other products" and "Biomass for electricity and heat production". This bioenergy certification system also covers the whole supply chain, including woody and waste wood biomass next to agri-residues and bioliquids (FAO and SEI 2010). The framework is a meta-standard approach. That is to say that GGL certification is based on other sustainability schemes like SFM certification systems (NL Agency 2013). The standard also includes CoC requirements and reviews the administrative process (FAO and SEI 2010). At the moment, 14 valid GGL certificates in European countries, the U.S., and Canada are listed on the homepage (GGL 2016).

3.2.3.6 Roundtable on Sustainable Biomaterials (RSB)

The Roundtable on Sustainable Biomaterials (RSB), formerly known as Roundtable on Sustainable Biofuels, is a global multi-stakeholder coalition that promotes biomass sustainability. As the name indicates, RSB can nowadays be applied to a wider range of biomaterials like forest products. "Short Rotation Coppice Woody Biomass", which is converted into energy pellets and chips, is covered by the system. Similar to FSC, RSB is a member of ISEAL Alliance (RSB 2016). The multi-stakeholder initiative brings together various actors from all over the world. There are no Vietnamese agents represented yet but farmers and growers of mainly biofuels from Malaysia, Indonesia, and Singapore do participate in RSB. Other stakeholders involved are industrial biomaterial producers, retailers, investors, NGOs and trade unions, environmental organizations, Intergovernmental organizations (IGOs) and research institutes, and other certification experts (RSB 2016).

Box 11: RSB Standard Components

- 12 Principles and Criteria (such as legality; greenhouse gas emissions; human, labor, and land rights; rural and social development; conservation of biodiversity; use of technology, inputs and management of waste etc.)
- Compliance Indicators: The checklist auditors use to assess compliance.
- Waste and Residues: How biofuel and biomaterial supply chains may use waste and residues, and the sustainability issues that apply.
- GHG Calculation Methodology: How to calculate life-cycle greenhouse gas emissions.
- Participating Operators: How to design the scope of certification, and manage compliance.
- Risk Management: Identification of risk levels, resulting in adaptation of audit intensity and frequency.
- Chain of Custody: Ensuring sustainability claims can be traced back throughout the supply chain, using various models (including ‘mass balance’).
- Communication and Claims: Requirements for using RSB trademarks (e.g. RSB name, RSB logo) and for compliance claims.

Source: RSB 2016

3.2.3.7 International Organization for Standardization (ISO)

ISO not only gives guidance for the work of standard setting and the working of certification systems, for example with the ISO 14001 sustainability standards containing among others “guidelines for environmental auditing” (Nussbaum and Simula 2013). In September 2015, the ISO standard on “Sustainability criteria for bioenergy” (ISO 13065:2015) was published. The standard’s objective is to define sustainability criteria for production, supply chain and generation of bioenergy via a process standard (Goh and Junginger 2011) and “applies to all forms of bioenergy, irrespective of raw material, geographical location, technology or end use (ISO 2016).

3.2.3.8 ENplus

The growth of the European and worldwide pellet industry brings about a need for consistent and high pellet quality. ENplus is a quality seal for wood pellets and accounts for the transparency of the entire supply chain. Quality requirements are described in the ENplus handbook⁵. Those requirements define particular thresholds for e.g. pellets’ diameter, length, moisture content, ash content, mechanical durability, pellet durability, net calorific value, or additives (ENplus 2016). However, this standard focuses less on sustainability issues of wood pellet production and use. Certified traders are to be found in Europe and Russia; certified producers operate e.g. in Europe, Brazil, Canada, Malaysia, Russia, and one company in Vietnam. This one company in Binh Duong achieved ENplus certification in December 2015 (Tsung Chang Industries 2016). By the time of the interview the company was searching for and contacting interested clients in Europe, current clients are located e.g. in South Korea and Japan.

3.2.3.9 Sustainability risk assessment: GRAS and BASIS

Global Risk Assessment Services (GRAS) offers an online tool for information on sustainability risks related to agricultural and forestry biomass. GRAS auditors carry out certification against schemes like ISCC, RSPO and FSC. The risk assessment covers the topics biodiversity, carbon stock, land use change, and social indices. Vietnam has not yet been assessed (GRAS 2016).

The Basis Bioenergy project is a platform for the sustainability risk assessment of wood chips supply. Services comprise the analysis of regional biomass potential, assessments of feedstock competition, and integration of sustainability criteria for biomass supply. The focus of the project is rather limited to European countries (BASIS 2016).

⁵ <http://www.enplus-pellets.eu/downloads/enplus-handbook/>

4 Supply chains of wooden biomass for CHP systems in Vietnam

The profitability of a combined heat and power generation plant depends largely on the constant supply of high quality feedstock at reasonable cost. Feedstock costs can represent 40% to 50% of the total generation cost. Consequently, the organization and management of the feedstock supply chain is being considered a key task towards safeguarding the economic viability of a CHP system. The following chapter will describe and analyze a supply chain of solid biomass for CHP systems based on wooden substrates including wood chips from plantation land, wood residues from wood processing and a combination of wooden substrates with other agricultural or agro-industrial residues in Vietnam. The main concern of the analysis will be the assessment of risks associated to the different stages of the supply chain to ensure a high degree of sustainability and profitability.

4.1 Quality requirements of wooden biomass for combined heat and power generation

Most critical for the quality of biomass feedstock is the energy, ash and moisture content as well as the homogenous structure of the feedstock. Those features which will have an impact on the cost of biomass feedstock per unit of energy are transportation, pre-treatment and storage. Moreover, feedstock quality affects the appropriateness of the conversion technology and is highly cost effective (IRENA 2012). The heating or calorific value of the type of wood varies little and is largely determined by the dry weight per volume or density. In general, softwood species are less dense than hard wood species but have a slightly higher heating value. However, on volume basis, hardwood provides more energy than softwood and tree branches have a higher heating value than bark (USAID 2014). As indicated in table 10, the heating value is mostly affected by the moisture content. For example, the moisture content of a substrate with 20 % moisture has a 40 % higher heating value compare to a substrate with 40 % moisture.

Table 10: Influence of moisture content on heating value

Moisture content (%)	Heating value (MJ/kg)	Heating value (Kwh/kg)
0	19.0	5.3
10	16.9	4.7
20	14.7	4.1
30	12.6	3.5
40	10.4	2.9
50	8.2	2.3
60	6.1	1.7

Table 11: Heating value of different wood substrates

Woody biomass	Moisture content (%)	Heating value (MJ/kg)
Fresh wood	40-50	10.9
Dried wood (medium storage condition)	20	15.5
Dried wood	15	16.6
Dried up wood	0	20.0
Sawdust	12-20	18.5-19.0

The moisture content of freshly harvested wood of approx. 50% is unsuitable for direct combustion in conventional biomass combustion systems. Under favorable weather conditions air drying of harvested wood can decrease the moisture content down to 20-30%, which allows for further processing, storage and combustion. The moisture content of residues from wood processing is usually low (10-20%), as it has passed a drying process in the factory. Saw dust from fresh wood-cutting is high in moisture and requires further drying prior to processing or conversion. The ash content in wooden biomass relates to the non-combustible matter in the substrate and ranges between 1–3%. Wooden material made from whole trees have a higher ash content than from stem only which is due to the fact that bark, leaves and small branches add considerably to the ash content. The ash content of processed wood and sawdust is usually low. Sand and dirt in the feedstock material result in an increased ash content which cause formation of clinker in the combustion chamber due to the higher melting point of ash. A further quality factor of feedstock material is homogeneity and

particle size, which affects the feeding and combustion process. Material of large particle size mixed with smaller sized material can cause incomplete combustion of the larger sized material, which will decrease the overall heating value.

4.2 Sources of wooden biomass and potential supply chains

4.2.1 Sources of wooden biomass

Wooden biomass suitable as feedstock for CHP plants can potentially derive from a variety of sources, including:

- Non-timber tree material from removal of dead and dying trees in protected and productive forests, urban trees, or trees impeding land development;
- Forest management harvesting – the removal of small diameter trees from dense stands for wildfire hazard fuel reduction, pre-commercial thinning of timber stands, or forest health improvement;
- Timber harvesting and logging residues – non-merchantable wood including branches, undersized trees, and non-commercial species removed during typical timber harvesting operations;
- Sawmill and other wood manufacturing residues – includes bark, undersized and un-used wood pieces (e.g. lumber edging and end trimming), sawdust, and other wood waste, sawmill residues;
- Landfill diversion – wood debris from tree removal and pruning, construction, demolition, discarded shipping materials (boxes, crates, pallets), and other trashed wood products;
- Chaparral management – removal of excess woody shrubs and plants for wildfire fuel hazard reduction or other forest management purpose;
- Dedicated forest plantations - fast growing trees specifically grown for pulp and paper, in- and outdoor furniture, and bioenergy conversion

As for Vietnam the main sources of wooden biomass for energy conversion in a CHP system available are:

- Wood material harvested from natural and plantation forest
As shown in Fig. 1 of chapter 2, the total volume of wood harvested from both natural and plantation forest in 2013 was approx. 17 M m³ of which 70 % or 12 M m³ were utilized for the production of wood chips. In 2014 about 130 wood chips production facilities were operating in Vietnam having produced and exported nearly 7.0 M tons of bone dry wood chips. Assuming all wood chips produced and exported in 2014 would have been utilized as fuel for power generation domestically, a total power generation capacity of nearly 900 MW could potentially be installed.
- Residue material from wood processing
Residual material from wood processing consists of saw dust, bark, black liquor, shavings, and solid pieces such as offcuts and chunks and arise during processing of timber after it arrives at the mill. The percentage of wood residue from sawn timber used in furniture production is about 60% of which 30% is normally used for drying purposes in the factory and 20% for material reuse such as particle board, ply wood etc. The remaining 50% of the waste material is being traded and mainly sold for pellet production (Woerner 2012). Wood processing residues are generally clean, uniform and low in moisture content and a relatively high energy density, thus providing a high quality source of fuel for CHP. With reference to the 4 M m³ of wood imported in 2013, mainly utilized for furniture production, the volume of residues available for energy utilization would be approx. 1.2 M m³.
- Wood pellets
The main input material for the production of wood pellets in Vietnam are residues from wood processing such as shavings, saw dust and slabs. Due to higher costs for drying and pre-conditioning, wood chips, small logs and residues from plantations are less suitable for pellet production and only make up a small amount of the wood pellet production. For logistical reasons almost all larger pellet production facilities are located near furniture processing plants, with about 80 % of the production located in the South of Vietnam. Total production of wood pellets in 2015 amounted to approx. 1.5 M tons mainly for export to Korea, China and Japan. Pellet prices range between 90-95 USD/ton FOB (interview with Tsung Chan Industries Co., Ltd.).

Wooden biomass material can also be blended with non-wooden biomass material i.e. rice husk to balance the available amount of wooden feedstock and to meet the demand of the CHP plant. Main non-wooden biomass material available as feedstock in Vietnam come from agricultural and agro-industrial sources and include rice straw, left over from corn and cassava harvesting, rice husk and bagasse from rice and sugar processing, respectively.

4.2.2 Wooden biomass supply chain and main actors involved

Unlike solar and wind energy which capture the natural energy in their immediate environment and convert it to electricity, the bioenergy resource has to be sourced, collected and delivered to the energy conversion plant. Because of the bulky and distributed nature and the relatively low energy density of biomass feedstock, the capturing and delivery process of the biomass material can be complicated and often poses high risks. This particularly applies for wooden biomass whose sources of capturing are mostly located in remote forest areas and require long transport distances.

The unique nature of each biomass power project in contrast to a fossil fuel based power generating system which can draw on long term experience and standards for supplying fuel material, biomass supply chains can hardly adopt standard procedures for harvesting and handling and requires comprehensive planning and management to assure a constant, high quality supply of feedstock.

The setting up of a dependable supply chain is one of the first steps towards developing a biomass CHP plant and affects the siting and the size of the facility as well as the combustion technology applied. For a wood fuel based bioenergy generation system, the feedstock availability and transportation of the wooden feedstock material often limits the capacity of the conversion system. Designing and planning of a supply chain also has legal implications and requires a wide range of permits, approvals, licenses etc. for the purchase and handling of wooden feedstock. This in particular applies for land use change issues or competing alternative uses of the biomass material. An environmental and social impact assessment study and public hearings are often requested by the local authorities to decide on the supply of wooden biomass for a particular CHP system.

A supply chain for wooden biomass (from trees and wood processing) generally consists of 5 major stages including harvesting and collection, transport, pre-processing, quality control and storage. All stages are interrelated and need to be set and optimized according to the specific site condition of the CHP plant. Details on the stages and major tasks involved are described in Fig. 8 below.

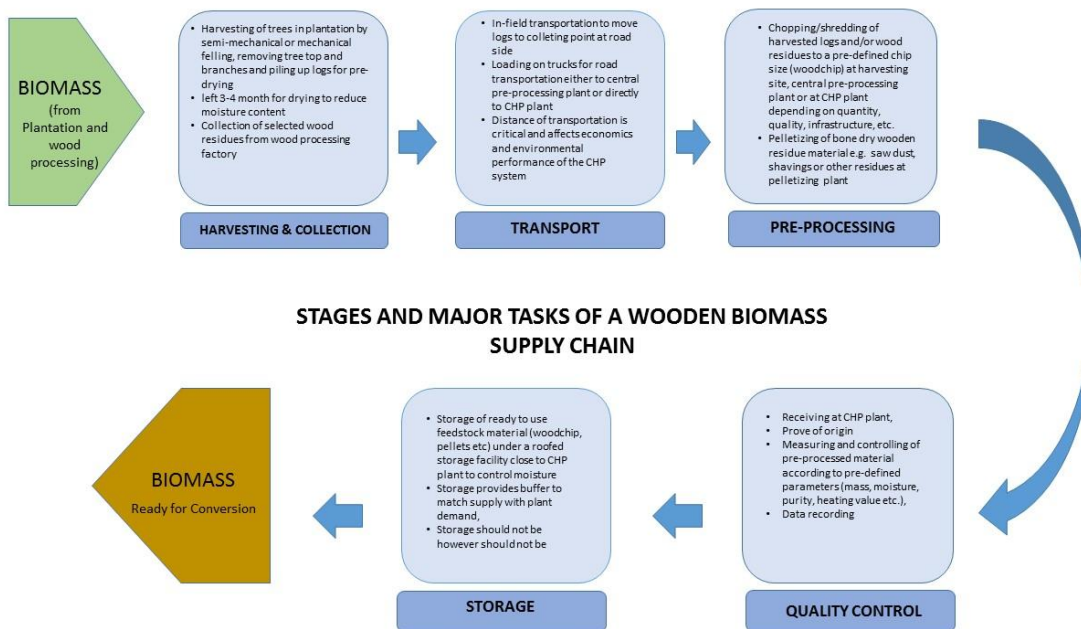


Fig. 8: Stages and major tasks of wooden biomass supply chain

Source: Source: Joel Tallaksen 2011, Biomass Gasification: A Comprehensive Demonstration of a Community-Scale Biomass Energy System, Chapter 6: Guidelines for Developing a Sustainable Biomass Supply Chain

The actors involved in designing, planning and handling a supply chain for wooden biomass for CHP are diverse and include a wide range of private and public institutions with varying roles. Some of these actors contribute to the flow of biomass along the supply chain, and others are involved in various governance roles. A general overview of the actors involved and their specific roles are presented in table 12. Due to the complexity of tasks, high capital and operating costs and the specialized expertise needed in organizing and managing a wooden biomass supply chain, the CHP plant often is restricted in handling all fields of the supply chain

independently. Therefore, it is important to first identify and analyze what activities are needed to support a stable and continuous operation of the supply chain on a regular basis to be either handled by the CHP plant or outsourced to contractors or specialized service providers. Contracting of specialized feedstock collectors and refiners to organize and manage a wide range of supply chain activities is common practice and allows CHP plant operators to focus on their core capacity to manage the CHP plant and generate heat and power efficiently. Normally this practice is applied in well-developed markets for heat and power generation where a firm legal and regulatory framework exists and necessary standards are in place. In newly developed CHP markets those conditions often do not exist and CHP plant owners are compelled to manage most parts of the supply chain by themselves to ensure a stable and continuous supply of feedstock. Conditions in Vietnam, where the RE sector up to date is only at an early stage of development and CHP systems are not yet widely applied, a more self-managed supply chain approach is applied to ensure risk management at all stages of the chain.

Local authorities play an important role in providing the necessary permits and approvals for setting up a CHP plant which also includes a verifiable design and planning of the biomass feedstock supply chain. A consultation with relevant authorities (i.e. the Department of Planning and Investment, the Department of Industry and Trade, the Department of Agriculture and Rural Development, and local communities) at an early stage is necessary to ensure all permits and approvals with regard to biomass feedstock acquisition and supply are granted. Often this process requires the involvement of an experienced local consultant to support the biomass resource assessment, identify potential biomass suppliers and to liaise with local authorities (GIZ - Biomass Power Investment Guidelines in Vietnam, preliminary version 2015). Environmental and social sustainability of the supply chain is a key issue to ensure a high level of acceptance for the development of a CHP plant among investors, banks, authorities and the general public. The use of certified biomass is in some cases a prerequisite for obtaining approval and support for the installation of a CHP system. Actors involved to enable certification of the wooden biomass include representatives from certification schemes (i.e. FSC, PEFC, etc.), a certification body and auditors for side inspection and verification. Independent consultants may provide advisory and training towards implementing a certification process.

Table 12: Actors involved in the wooden biomass supply chain and major roles

Actors in the wooden biomass supply chain	Description	Role
Forest (plantation) owner/ operator	Large scale state owned company, small holder, cooperative or group of small holders which have the legal right to operate/ utilize a defined area of forest/ plantation land	<ul style="list-style-type: none"> - Producer and supplier of wood material for CHP plant - Sell raw wood or pre-processed wooden material (woodchip) directly to CHP plant or through contractor - Large/ medium scale plantation owners may partner directly with CHP plant owner/ operator, if small holder join in groups or cooperative for partnership - Act in competitive market and are profit oriented maintain forest plantation land in good condition to ensure long term economic benefit
Wood processing factory owner	Owns and operates the wood processing factory e.g. saw mill, furniture factory	<ul style="list-style-type: none"> - Producer of various kinds of wood products (finish or half- finish) for domestic and international market - Has residue material left from wood processing left and sells as input material to other industries (particle board, wood pellet producer, etc.) - May partner with CHP owner directly for the supply of wood residues or through contractor - Acts in a competitive market and is profit oriented - If export oriented normally CoC certified
Contractor	Entrepreneur contracted to perform forest management activities such as planting, harvesting, pesticide application, transportation, etc. for example forestry or agricultural entrepreneurs, and transportation and storage	<ul style="list-style-type: none"> - Has a contractual agreement with the owner of the forest/plantation to perform a defined range of tasks including cultivation and exploitation of the forest land - Contractor is contractual partner of CHP plant operation for supply of wood/wood chips, wood residues to CHP plant - May arrange for full range of supply services including collection, transportation, and pre-processing
Biomass refiner	Company which buys biomass raw material (e.g. wood, husk, bagasse) to produce refined biomass fuel (solid or liquid) for sale, for example woodchips or pellets	<ul style="list-style-type: none"> - Producing and selling biomass fuel with specifically defined standards according to customer demand (tailor made) - Supply biomass with high energy value (pellets or torrefied biomass) to be used for co-firing and large scale CHP plants in large quantities and carried over long distances
Trader or distributor	Organization or person that buys and sells biomass or refined biomass products on the market	<ul style="list-style-type: none"> - Trading of many kind of biomass feedstock including wooden biomass - Services are often utilized on short term basis to balance shortcomings in the supply chain - Assist in sourcing of available biomass on commission basis - Well connected in the area
Haulage company	Operates a truck fleet to provide transport services for goods	<ul style="list-style-type: none"> - Provides transport service on request or on fixed contract basis
CHP owner or operator	Operates CHP and produces of heat	<ul style="list-style-type: none"> - Invests in the CHP

	and power electricity and/or heat from biofuels	<ul style="list-style-type: none"> - Manages the CHP plant and is responsible for the overall performance - Designs, plans and organize the supply chain - Decides on outsourcing certain stages of the supply chain - Quality control and monitoring of biomass supply - Risk management
Investor	Private or public Investor in bioenergy or bioenergy related projects	<ul style="list-style-type: none"> - Invests in CHP based on favorable economic return - Set benchmarks for sustainability of the project along the value chain - Corporate Social Responsibility (CSR)
Financing Institution	Private or public bank, domestic or international providing loans for biomass CHP projects	<ul style="list-style-type: none"> - Carry out risk assessment on financial viability including availability and constant supply of biomass feedstock - May request environmental social impact assessment - Provide loan for project financing
Certification scheme or initiatives	Existing or newly developing organizations or initiatives setting standards for achieving a sustainable production of forest based biomass, e.g. FSC or PEFC	<ul style="list-style-type: none"> - Provide a framework for certifying sustainable forest management and processing of certified forest products - Provide guidelines for the certification process and provide training - Advice on setting up national certification schemes
Certifying body	An independent third party organization accredited under a certification scheme.	<ul style="list-style-type: none"> - Provide services towards evaluating stakeholders seeking certification - Issue certificates and ensure on-going conformance
Auditor	Employee of a certifying body or an independent consultant hired by a certifying body	<ul style="list-style-type: none"> - Assesses and verifies SFM and CoC against the set standards
Public Administrator (public authority)	Institutions that regulate actors involved in the bioenergy sector and administer and enforces laws and regulations (set by the legislator) related to sustainable bioenergy systems, e.g. national/provincial Forestry, energy authorities,	<ul style="list-style-type: none"> - Sector planning on central and local level - Issue permits and approvals for utilizing wooden biomass from forest and plantations as fuel for CHP plant - Controlling, supervising and enforcing the compliance with relevant law and regulations - Provide advisory service on technical and administrative issues
Technical Expert	Consultant/Researcher on relevant issues e.g. forest management, wood processing, certification etc.	<ul style="list-style-type: none"> - Provide advisory service on request to concerned actors on technical, economical, financial etc. issues
Industry Associations	Non-governmental organization actively involved in developing the specific industry and markets e.g. wood processing industry, members include business operators, consultants, researchers, and other individuals	<ul style="list-style-type: none"> - Networking and lobbying for stronger support - Public relation - Representing the industry at fairs, conferences etc.
International Development Institutions	Institutions/ organizations which provide technical and financial assistance through Governmental and Non-Governmental cooperation projects in specific areas of development e.g. Forestry, Energy etc. WB, GIZ, USAID, etc.	<ul style="list-style-type: none"> - Provide support developing adequate framework conditions for efficient and sustainable resource utilization in forestry and energy - Draft guidelines (technical and economic) on selected topics to support decision making - Carry out pilot projects etc.
NGO	Non-governmental environmental organization actively involved in questions around bioenergy sustainability	<ul style="list-style-type: none"> - Advocacy on sustainable resource utilization - Awareness raising among the public - Stakeholder consultation - Conflict management

Source: Author's elaboration

4.2.3 Supply chain models based on wooden biomass

Depending on the available types and quantities of wooden and other biomass material in a distinctive location and the capacity and capability of the CHP facility to acquire and handle the biomass material, different supply chain models can be applied. The following is a description of the structuring and configuration of the supply chain and its interrelation with the actors involved.

Table 13 provides an overview of the amount and quality of wooden and non-wooden feedstock material to match the demand of a 10 MW_{el} CHP system, at 25 % efficiency, operating over 7,900 hrs per year.

Table 13: Quantity and quality of wooden biomass and rice husk for a 10 MW_{el} CHP plant

Biomass	MC ¹ (in %)	LHV ² (MWh/t)	Energy Density (MWh/ m ³)	Quantity (for a 10 MW _{el} inst. capacity plant)	
				(t/year)	(t/day)
Log wood from plantation stacked	20	4.1	1.8	77,300	234
Woodchip from plantation pre-dried (stems and residues)	30	4.3	0.8	73,700	223
Saw milling other residues (shavings and saw dust)	13	4.5	0.5	70,400	213
Wood pellets from wood processing residues	10	4.7	2.7	67,200	203
Rice husk	10	4.3	1.2	73,600	223

Source: FAO 2015, Wood Fuel Handbook;

¹⁾ MC – Moisture content, ²⁾ LHV – Lower Heating Value

As shown in table 13 the quantity of biomass resources required to meet the demand of a 10 MW_{el} CHP plant is large and can be up to 220 tons per day for woodchip with a moisture content of 30%. It becomes obvious that the design and management of the supply chain to handle this amount of feedstock is crucial to ensure a long-term steady and stable supply. Therefore, the structure of a supply chain and the interrelations and coordination among its actors involved to facilitate the different stages of the supply chain need to be set in such a way that the requirements for an efficient operation of the CHP plant are met. Beside the purchasing price of the biomass material, handling and logistic cost are major cost components in a supply chain and need to be optimized according to the prevailing circumstances of the CHP facility. Moreover, environmental and social aspects of the production and handling of the biomass material need to be controlled closely to fulfill legal requirements and public acceptance.

While there are a variety of different approaches to organize and manage the supply chain, two basic models are in place, applicable for a wide range of CHP facilities, namely the producer based and the aggregation contractor based model. The producer based model as illustrated in Fig. 9 is designed in such a way that the CHP plant owner directly signs contracts with individual producers or a group of producers of biomass material to be delivered directly to the CHP facility.

Producers of wooden biomass can be plantation owners which produce, harvest, collect, pre-process and transport the material to the CHP plant where it will be further conditioned and stored for subsequent conversion. Advantage of such a system is that the CHP plant owner/operator has a direct relationship with the producer and can easily trace back the origin of the material and react fast to potential misconduct. It also allows the CHP plant to build up a close relationship with the supplier which allows for a reliable and trustful long term business partnership. Disadvantage of such a model can be the large number of suppliers to be handled to meet the demand of biomass material as it increases the effort for administrative and contractual management. In addition, due to the variation of suppliers from different locations, the quality of wooden biomass delivered to the plant may not be of unified standard which therefore has to be controlled closely on a regular basis. As a result, feedstock may have to be balanced by mixing and/or blending of different material to meet the required standard. With regard to the supply of wooden biomass from plantations, good command of knowledge on plantation management is required by the CHP operator to understand the dynamics in production and seasonal availability of the material. For example, harvesting wood from plantations underlies seasonal variability due to climate conditions which requires sufficient external or internal storage facilities to bridge potential delivery gaps. Overall, a producer based supply chain model is more suitable for small to medium scale CHP facilities with some flexibility in conversion requirements, with sufficient in-house capacity for processing and storage and a well-established local network of potential biomass producers.

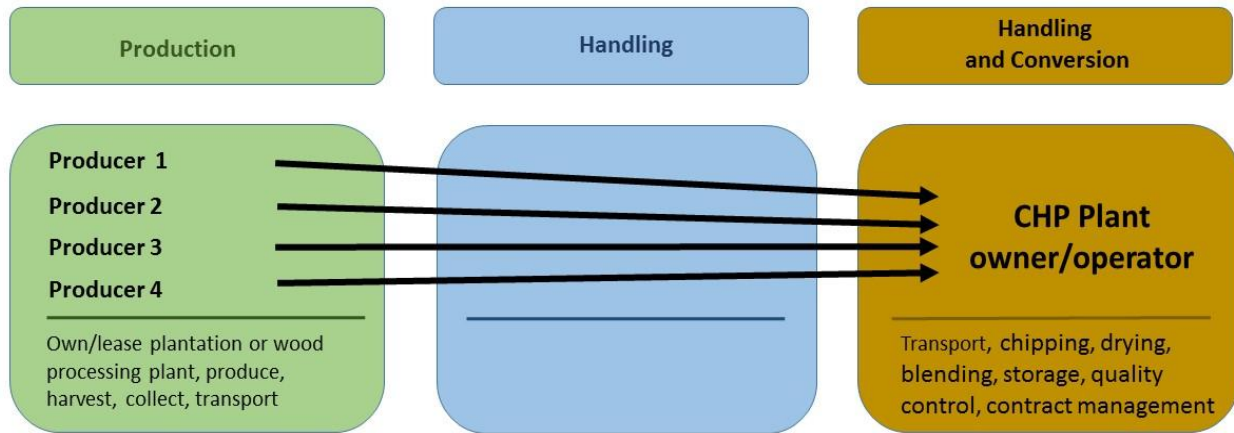


Fig. 9: Producer based supply chain model

Unlike a producer based model, an aggregation contractor based supply chain model is more of a centralized structure where a contractor organizes and manages most of the tasks along the supply for a constant supply of biomass material to the conversion facility. Depending on the contractual arrangement between the contractor and the CHP plant the contractor either limits his services to only sourcing and purchasing of the biomass material, intermediate storage and subsequent delivery to the conversion facilities or provides a full service package managing the entire chain from harvesting/collecting to pre-processing, intermediate storage and delivery.

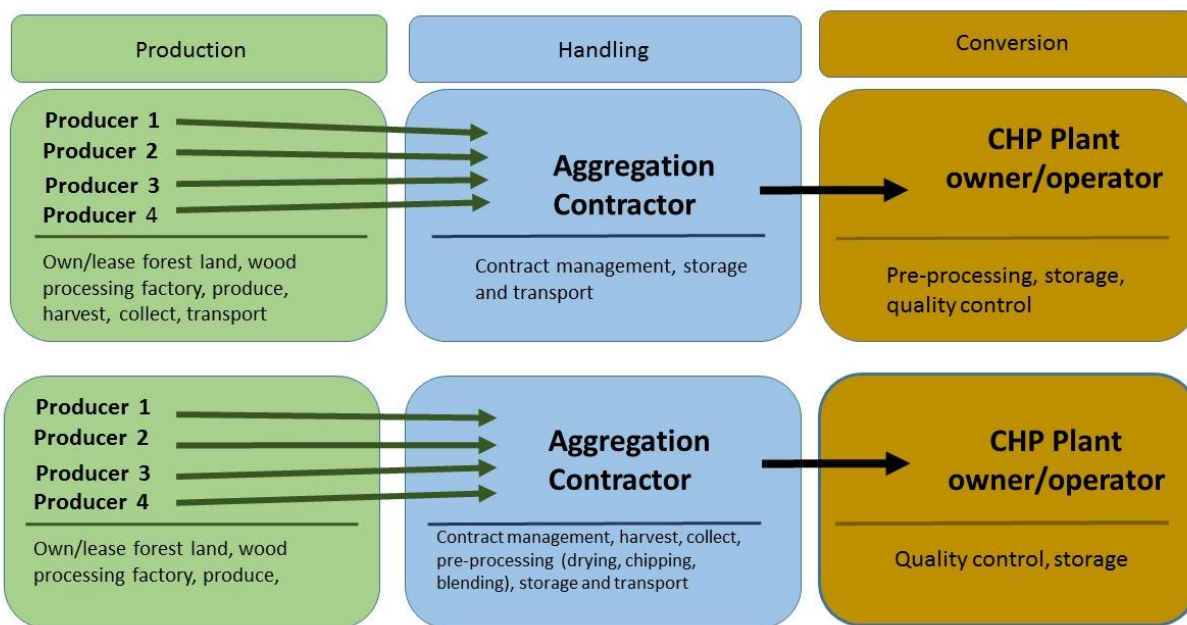


Fig. 10: Aggregation Contractor based supply chain model

Basically, the advantage of outsourcing parts of the supply chain to an aggregation contractor lies in the reduced efforts of the CHP plant in managing the supply chain. A key task is the material sourcing and contractual arrangements with a range of producers which can be a lengthy and cumbersome process and requires in-depth sector knowledge, a well-established network in the region and good experience in dealing with local producers and authorities. On the other hand, contracting often limits the possibility of the CHP plant owner to identify and act against illegal and unsustainable practices of production and processing and increases the risk of being supplied with wooden biomass of illegal origin or unsustainable production.

4.3 Sustainability risks and considerations entailed in different sources and stages of supply

The potential of bioenergy to contribute to sustainable development is large, however due to the complexity of the interaction between nature, man and technology, the way towards accomplishment is difficult and associated with a number of risks involved. In principal sustainability of a bioenergy system is indicated by its economic, environmental and social impact which to a large extent is safeguarded by complying with the existing legal framework and regulations.

There is a number of sustainability risks associated with an increasing use of wooden biomass for energy conversion energy. Table 14 provides an overview of potential sustainability risks along the supply chain, which provides orientation for a thorough risk assessment during planning and management of the different stages of the supply chain. Risk aspects are structured according to their legal, economic, environmental and social impact during sourcing and production of wooden material, harvesting and collection, transportation and pre-processing up to storage and quality control. Sources of wooden biomass include wood from natural forest and plantations, residues from plantation harvesting, residual wood material from wood processing and wood pellets from pellet factories.

In the Vietnamese context the most critical risks related to adverse environmental and social impacts of a wooden biomass supply chain can be summarized as follows:

- Land use change for claiming plantation land leading to increased GHG emissions;
- Land use for plantation based on intensive production methods with short rotation cycles and inadequate management practices causing adverse impact on soil, water and biodiversity;
- Illegal logging and import of illegal wood material
- Allocation of land use rights for plantation and forest management causing disadvantages for minority groups and communities
- Legal employment and safety precautions for workers in plantations and wood processing factories
- Fossil fuel consumption for handling and transportation of biomass resulting in increased GHG emissions
- Red tape and lack of transparency on granting permits, licenses and approvals by local and central government

While actually most of the sustainability aspects regarding forest management and wood processing in Vietnam are covered by the existing legislation, the monitoring, control and enforcement of the regulations by local authorities is still weak. As a result, illegal practices in the forest sector are common, impacting on the legality of the wood material and sustainable utilization of forestland. This circumstance poses a serious risk for the procurement of wooden material as feedstock for bioenergy and needs to be carefully considered when purchasing wooden feedstock material. According to NEPcon (2015) the risk of purchasing wood from plantations may be lower as compared from natural forest, since control and legal compliance of the production in plantations is better defined and enforced. However, there are still specific risks in many areas and efforts for risk mitigation are high.

With regard to residual wood material from wood processing and pellets production, about 70% of the total amount of wood processed stems from imported wood material. The share of illegally imported timber is estimated to be as high as 18% up to 50%, and much of the illegal timber flowing into Vietnam is produced in the neighboring countries Laos and Cambodia (Chatham House, 2014 and Forest Trends 2012). Therefore, the purchase of wood residues or pellets is risky and may easily result in purchasing illegally sourced feedstock material.

An option to mitigate risks, for both, wooden material from plantation or wood residues from processing including wood pellets is to purchase wooden material which originates from certified forest management practices or Chain of Custody certified material. While forest management certification in Vietnam is not yet widely applied with only 14 forest entities covering an area of about 157,000 ha forest land currently being certified (FSC fact and figures, July 2016), CoC certification is progressing fast and being applied by around 470, mainly export oriented wood processing companies (FSC 2016). With the government's policy adoption towards the promotion of sustainable forest management, a national certification scheme is currently being developed which should foster a wider application of certification, thus lowering the risks for a sustainable wooden biomass supply chain management for CHP application in the future.

Table 14: Sustainability risks in the supply chain of wooden biomass

Stages of supply	Sustainability risks			
	Legal	Economic	Environmental	Social
Sourcing and contracting	<ul style="list-style-type: none"> - Land use rights certificate including permits for land conversion - Permits, authorization, approvals for sourced feedstock, - Contractual arrangements with specified terms of purchasing in compliance with legal requirements 	<ul style="list-style-type: none"> - Realistic estimation of biomass resources available - Contractual conditions of feedstock in terms of quantity, quality and time - Pricing and cost effectiveness of supply 	<ul style="list-style-type: none"> - Conversion of natural forest to plantation - Plantation management and intensification vs. conservation and protection - Short term (3-4 years) vs. long term (10-15 years) rotation - Impact on soil, water, air and biodiversity - Land use change for setting up plantation and impact on GHG emission - Illegal wood and deforestation - Damage by forest fire and natural calamities e.g storm, floods, 	<ul style="list-style-type: none"> - Local community and indigenous people participate and benefit from biomass production - Competitive use of biomass resources in rural economy
Harvesting and Collection	<ul style="list-style-type: none"> - Employment contracts for plantation and factory workers - Permits, authorization, approvals for logging of wooden biomass, 	<ul style="list-style-type: none"> - Harvested wood from plantation is air-dried in the field to decrease moisture content prior transportation to save fuel and transportation cost 	<ul style="list-style-type: none"> - Harvesting intensity and method is selective and spares soil, water and natural habitat (whole tree harvesting, stump and residue removal) - Proof of legality for residual wood collected from wood processing 	<ul style="list-style-type: none"> - Safety precautions for plantation/forest worker including protective gear - Payment according to legl
Transportation	<ul style="list-style-type: none"> - Legality proof of goods transported (e.g. VAT invoice, packaging list etc.) - Vehicle registration and certification of condition - Driving license 	<ul style="list-style-type: none"> - Transportation is energy intensive and highly cost effective 	<ul style="list-style-type: none"> - Fuel consumption impacts GHG emission 	<ul style="list-style-type: none"> - Capability of driver
Pre-Processing	<ul style="list-style-type: none"> - Proof of legality of raw material or processed material - Permits, license etc. for setting up and operating pre-processing plant 	<ul style="list-style-type: none"> - Natural drying and use of waste heat from CHP plant impacts cost - Moisture of material impacts transportation cost - Moisture content and particle size corresponds with requirement of conversion technology 	<ul style="list-style-type: none"> - Natural drying and use of waste heat from CHP plant impacts GHG emission - Air and noise pollution from processing 	<ul style="list-style-type: none"> - Workers ability and employment conditions - Safety precautions - Public acceptance of processing plant
Storage	<ul style="list-style-type: none"> - Permits, license etc. for setting up and operating storage facility 	<ul style="list-style-type: none"> - Storage location (outside or inside CHP plant) - Storage time impacts size of storage facility, operating conditions and heating value and is cost effective 	<ul style="list-style-type: none"> - Air pollution (dust and odor) - GHG emission if moisture content too high 	<ul style="list-style-type: none"> - Workers ability and employment conditions - Safety precautions - Public acceptance
Quality Control	<ul style="list-style-type: none"> - Transparency and control of legal compliance for all steps of supply chain 	<ul style="list-style-type: none"> - Transparency and control of CHP system management for highest and of CHP plant for efficiency 	<ul style="list-style-type: none"> - Transparency and control of environmental impact 	<ul style="list-style-type: none"> - Transparency and control of social impact

5 Costs and benefits of solid biomass sustainability certification

5.1 General overview of potential direct and indirect costs, and benefits of certification

In order to assure sustainability of a wooden biomass supply chain for a CHP conversion plant, sourcing and procurement of certified feedstock material may be a viable option to mitigate risks. Certification however, is costly and will add to the costs of feedstock material which impacts the overall economics of the CHP system. Therefore, the costs of certified wooden material as feedstock for CHP conversion have to be carefully assessed and weighed against the benefits. The following chapter shall provide some insights into the costs and benefits of certification of wooden biomass material, both at production and supply chain level. Accordingly, FM and CoC certification is being considered and analyzed. Since the FSC scheme is the one most widely applied (in terms of CoC certificates) and the only one currently applied for FM in Vietnam, it shall serve as a reference for describing and analyzing the costs and benefits.

5.1.1 Cost of certification

5.1.1.1 Forest management certification

Total FM certification costs are made up of two categories, the pre-certification or initial costs to obtain certification and the post-certification costs or annual costs to maintain certification. As summarized in Fig. 11, for both categories costs are divided into direct and indirect costs. Direct costs of certification are related to the certification process itself whereas indirect costs are costs embedded in the operations to safeguard compliance with the certification standards.

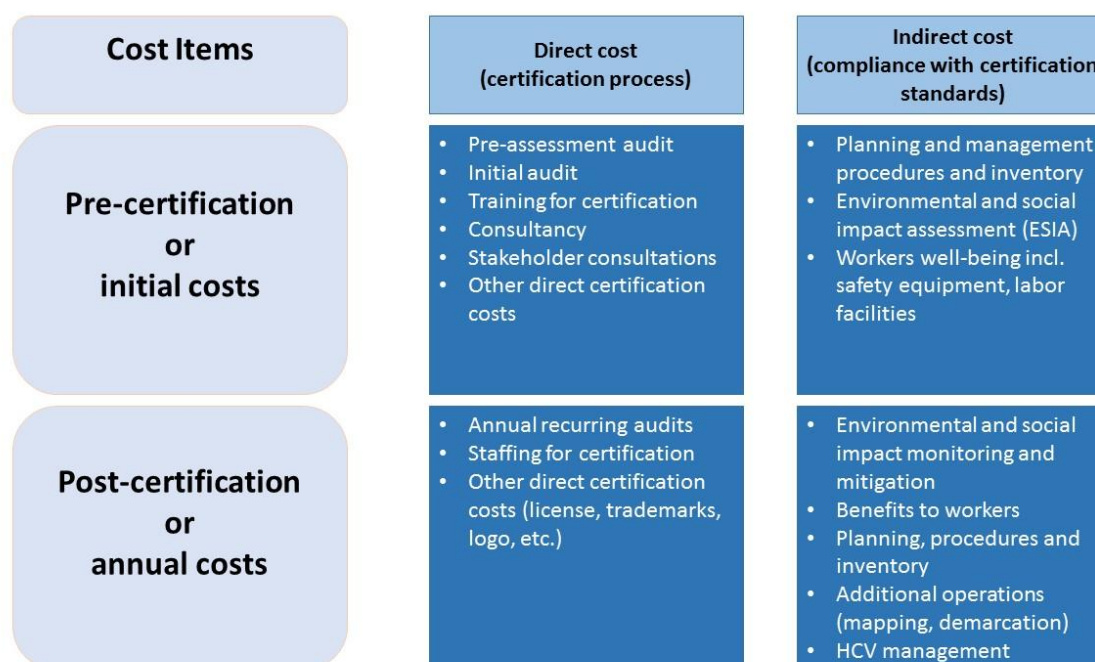


Fig. 11: Overview of costs incurred for FSC Forest Management Certification

Source: Profitability and Sustainability in Responsible Forestry, WWF Report 2015

Direct costs associated to **pre-certification** include the costs for the pre-assessment or scoping audit to evaluate the existing forest management practices of the forest management unit (FMU) and the capacity to make necessary adjustments to the management system in order to participate in a certification scheme. A pre-assessment audit is mandatory for plantation forests exceeding 10,000 ha, non-plantation forests larger than 50,000 ha and special forests containing high conservation value. After the decision is made to join the certification scheme, an initial auditing will be conducted to verify that all requirements for the certification have been met

according to the set standards. The expenditures associated to pre-assessment and initial auditing are mainly for hiring a third party auditor from an accredited certification body and depending on the capacity of the FMU to engage a technical consultant to support the auditing process. Other direct expenses for pre-certification include basic training for internal staff on the certification process, and initial stakeholder consultations. **Indirect costs at pre-certification** level arise mainly for the development and adjustment of the FMU management system including planning, monitoring and documentation procedures, for conducting an environmental and social impact assessment and the improvement of social conditions for workers, such as investment in safety equipment and labor facilities.

Total costs for obtaining certification differ widely and depend largely on the capacity of the FMU to handle the planning and administrative procedures to prepare for the certification and the size and type of forest (e.g. natural forest or plantations) to be certified. In general, medium to large FMUs are better prepared for certification and pre-certification costs are lower than for small holder FMUs. Because of the complexity of the forest management system, costs of certification for natural forest are usually higher than for plantation forest. According to a study from Richard Laity et al. (unpublished) actual costs for initial FSC certification for a small to mid-sized plantation of up to 5,000 ha in Vietnam amount to approximately USD 30,000. In a survey conducted by WWF on global level average pre-certification costs are USD 3.74 per m³ of certified wood, ranging from up to USD 4.01 for natural forest to up to USD 2.73 for plantation forest, whereby the auditing cost make up about 30% of the total pre-certification costs. The average time required for FMUs to achieve certification as assessed by WWF (2015) was three years, varying between 1.5-4 years. Certification of natural forests took about twice as long to complete as plantation forests. There was no difference in time to get certified between small and medium and larger companies.

The FM pre-certification process is completed when the certification is issued. Thereafter the certification is valid for a period of five years, during which the FMU is required to comply with the management standards as set by the certification scheme. The associated activities to maintain certification are cost effective following the same cost structure as for pre-certification. **Direct costs for post-certification** are mainly being incurred for the annually recurring compliance audits, staffing for additional work on certification and license/trademark fees which represent about 15-20% of the total ongoing costs. **Indirect costs** make up the bulk of the annual certification costs accruing for about 80% of the total costs, mainly spend for operational activities to comply with the certification standard including implementation of environmental and social impact mitigation activities and associated monitoring, annual planning, data recording and documentation, regular liaising with stakeholders and HCV management. HCV management costs are widely considered as opportunity costs which implies a reduction in productive forest area by setting aside land for buffer zones and conservation forest area, resulting in potential income reduction.

Similar to the pre-certification costs, annual post-certification costs vary considerably and again mainly depend on the capacity of the FMU to handle the certification process as well as the size and type of forest (e.g. natural forest or plantations) to be certified. Generally, the costs of certification for small holders are relatively higher than for medium to large FMUs and lower for plantation forest compared to natural forest (Laity et al. 2015, WWF 2015).

Addressing the complexity and relatively high cost of certification which widely eliminates small holders and less wealthy FMUs in developing countries from certification, FSC promotes the SLIMF certification. The SLIMF certification process is simpler, with stream-lined procedures and mainly arranged as group certification. Besides sharing the cost of certification, the group members benefit from information sharing, better economies of scale when negotiating prices and marketing the product. SLIMF is often part of a FCS support program and backed by the Government or international donors (Putzel et al. 2012).

5.1.1.2 Chain of custody certification

CoC certification sets the standard of a controlled flow of certified wooden material throughout the supply chain from the producer to the end user. The certification therefore, focuses on the procurement, processing, volume accounting, sales and labelling of certified material to ensure the integrity of claims and trademark usage.⁶ Potential candidates for CoC certification include FMUs, loggers, contractors, traders and wood processors.

As assessed from saw wood manufactures in Malaysia and summarized in table 15, the costs of CoC certification are divided into three categories: (1) costs to meet CoC standard (indirect costs), (2) initial auditing cost to obtain CoC certification (direct cost) and (3) costs for semi-annual/annual surveillances (direct costs). The largest cost factor is compliance costs for attaining certification with a mean rate of 85% of the total cost which cover the costs for staff training, document preparation, documentation, identification and

⁶ <http://www.nepcon.net/sites/default/files/library/NEPCon-FSC-CoC-FactSheet.pdf>

traceability as well as inventory and storage procedures to segregate certified from non-certified material. Whereas the costs for a one-time initial assessment audit and surveillance visits over 4 years only account for 2% of the total certification costs for each component.

In Vietnam, with more than 470, mostly wood processing companies holding FSC CoC certificates, initial auditing and annual surveillance costs including auditing fees and travel costs range between USD 5,000–10,000 for a 5-year period (Interview SGS, Woodlands, Laity et al.). Records on the amount of indirect costs for compliance measures were not available.

Table 15: Cost structure and average expenditures of CoC certification for sawn wood manufactures in Malaysia

Cost Category	Activities	Average costs		
		RM/m ³	USD/m ³	%
1) Requirements to attain CoC certification standard (indirect costs)	- Training	0.07	0.02	1
	- Documentation	0.09	0.02	2
	- Storage	0.47	0.11	8
	- Packaging and labeling	4.83	1.18	85
Subtotal		5.46	1.33	96
2) Initial Assessment (direct costs)	- Initial auditing	0.12	0.03	2
3) Surveillance (direct costs)	- Semiannual auditing for first 2 years, thereafter annually if no major corrective action require (CAR)	0.12	0.03	2
Total		5.70	1.39	100

USD exchange rate 4.10 against Malaysian Ringgit (RM)

Source: Journal of Tropical Forest Science 23 (2) Assessment of Chain-of-Custody certification costs for sawn-wood manufacturers in Peninsular Malaysia

5.1.2 Benefits of certification

The benefits associated with FM and CoC certification are classified as direct and indirect benefits and can be assessed in monetary and non-monetary terms (Schreiber and Vincent 2012).

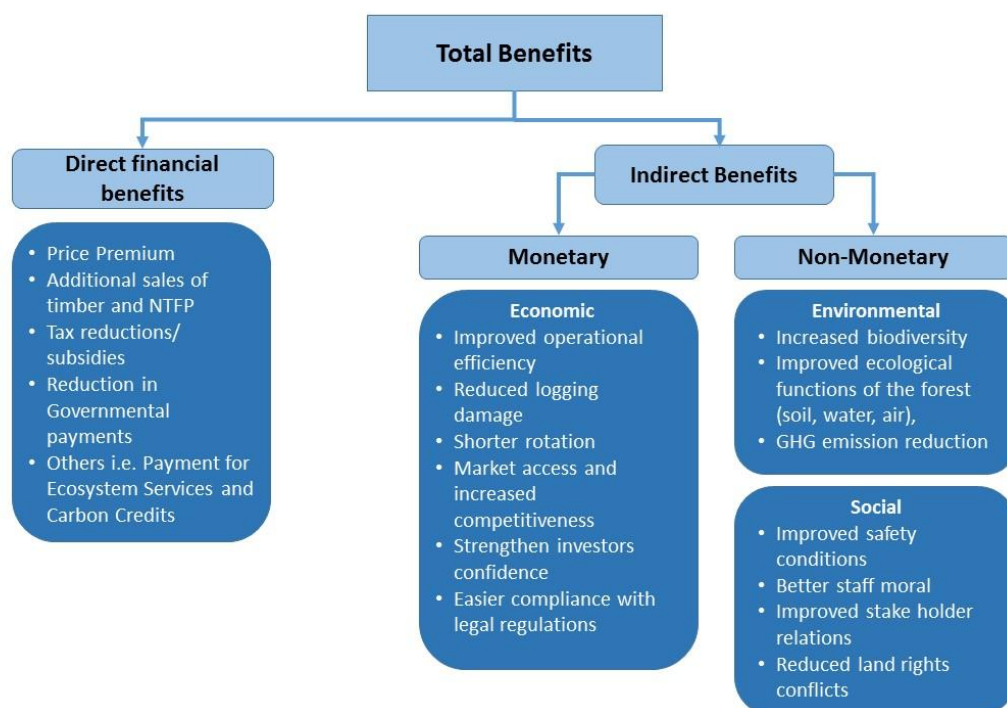


Fig. 12: Overview of potential benefit incurred for FSC Forest Management Certification

Source: Schreiber and Vincent 2012

Direct financial benefits are generated by price premiums and additional sales of certified timber and non-timber forest products. The rate of price premiums is not uniform and differs widely depending on market demand and product type. According to a study of Laity et al. (unpublished), certified wood products are favored by European, American and Japanese markets where awareness and legal regulations for forest protection and sustainable production are more distinctive. However, premiums are mostly limited to solid wood products (sawn timber and round-wood) and less for processed wood. Premiums can be as high as 20% compared to non-certified wood. In another study conducted by WWF (2015), average price premiums of USD 2.57 per m³ certified production or 2% of the annual turnover were generated, representing 42% of the total financial benefits of FSC certification. In the same study it was noted that price premiums for tropical forest producers were higher compared to temperate forest producer and certified plantation wood obtained slightly higher premiums than from natural forests. Another direct financial benefit for certified wood products are tax incentives or other subsidies which often are provided by the Government or NGOs to promote SFM and to curb deforestation. Yet not widely utilized are financial benefits from certification stemming from the “Payment for Eco-Services” (PES) and carbon credits from GHG emission reduction under existing compliance (CDM) or voluntary (VER) trading system. Payments for ecosystem services compensate for environmental services of enhanced forest ecosystem functions that benefit human wellbeing, including biodiversity, climate regulation, flood regulation, soil erosion prevention, water purification etc. (RECOFCT 2015).

Indirect benefits of monetary value are mainly achieved through improved operational efficiency, i.e. by applying the method of reduced impact logging (RIL), a key component of FSC standard. RIL allows for a more systematic planning, recording and documentation resulting in reduced logging losses and a shorter rotation cycle which positively affects the profitability of the forest production. Marketing of certified wood is more effective and poses a competitive advantage over non-certified wood. This can be of particular importance under unfavorable market conditions as it reduces the risk of losing clients and at the same time strengthens investors’ confidence.

Indirect benefits of non-monetary include environmental and social benefits derived from improved forest operation and management. As an integrated part of the certification compliance scheme, environmental impact mitigation and conservation measures lead to increased biodiversity, enhanced ecological functions of the forest, improving soil conditions, water retention and air quality. Moreover, certification impacts GHG emission reduction by afforestation and reforestation as well as by slowing down the rates of deforestation and forest degradation. Social benefits tackle the well-being of workers through improved working conditions, i.e. housing, occupational safety, employment and social security. Improved social conditions across the company benefits the staff and the management alike as it increases responsibility and overall working moral leading to higher productivity and reduced staff fluctuation. Regular external stake holder consultation is a key requirement of the FM certification process, allowing concerned individuals, local authorities and local communities to express their opinion and concern on relevant issues. The benefits are significant and bring about recognition and better understanding of each other’s interests and concerns, preventing conflict and lengthy bureaucratic processes. The government of Vietnam is currently testing various forest payment mechanisms for ecosystem services, which are integrated in FSC certification.⁷

Though, the benefits from FM and CoC certification are obvious and highly relevant towards achieving sustainable forest and supply chain management, many of the benefits cannot be quantified directly in monetary terms (RECOFCT 2015). Uncertainty therefore remains whether the return of investment from certification is sufficient to make certification an attractive tool to manage the risk associated with forest management. The cost of certification, its complex nature to implement and a lack of financial and management capacity combined with an initially slow return, still outweigh the direct financial benefits, currently preventing potential FMUs to invest into certification. While large industrial forest companies are more flexible to meet the necessary requirements for investment, smallholders are hardly prepared to benefit from certification. With only about 1% of the total forest area currently certified in Vietnam, much effort is still needed to overcome the obstacles for a wider application of certification. Continued support from government, NGOs and ODA is still needed to further promote FM certification systems to deliver sustainability benefits both on FMU and national level.

5.2 Case study: sustainable wooden biomass supply chain for CHP

The following case study refers to a CHP project which is currently being developed by the German CHP project developer PROLIGNIS in Vietnam. Focus of the case study is to reflect on the sustainability of a wooden biomass supply chain for CHP and

⁷ <http://forces.fsc.org/vietnam.28.htm>

applying certification of the wooden feedstock material as a potential tool for risk mitigation. Key issues to be reviewed include the conceptual approach of a certified supply chain, costs and benefits and its limiting factors for application.

The CHP system

With the support of the Deutsche Investitions- und Entwicklungsgesellschaft mbH (DEG), PROLIGNIS has developed and assessed the feasibility of a CHP system designed to supply heat and power to a manufacturing plant near Hanoi.

Table 16: Design features of the CHP conversion system

Item	Characteristics
Plant type	Combined Heat and Power Plant (CHP)
Location	Thanh Oai Industrial Complex, Thanh Oai Dist., Hanoi
Installed electrical capacity	2.8 MW gross
Firing capacity	13 MW
Combustion system	Grate firing with steam generator
Turbine	Extraction condensing
Operating hours per year	8,000
Overall efficiency	53%
Energy contracting model	Direct supply of heat and power

Source: Prolignis 2016

As summarized in table 16, the CHP conversion system is designed with an overall electrical capacity of 3.0 MW which allows meeting the factory's electricity demand of about 19,000 MWh to be supplied over 24 hours at 330 days. The remaining thermal energy from power generation will be utilized as process steam for sterilization and in an absorption chiller for cooling purposes. Equipped with modern biomass CHP conversion technology to ensure a constant and reliable supply of heat and power over the year the CHP operates with an overall performance efficiency of about 53%. All electricity and heat generated from the CHP plant is directly supplied to the German enterprise with production facilities in Viet Nam, allowing the factory to operate independently from the national grid. Due to the highly sensitive production process, a reliable and uninterruptible supply of energy is a key functional requirement of the CHP conversion system.

5.2.1.1 Feedstock supply chain

Apart from the conversion efficiency of the CHP plant, the operational management and the valorization of the energy generated, the feedstock supply chain is the most critical factor to influence the economic viability of the CHP system. Feedstock cost can represent up to 50-70% of the total running cost of the CHP depending on the price of the material and associated supply costs. Beside the direct economic risks involved the feedstock supply chain has a direct impact on the environment, social conditions and climate change.

To identify the feedstock material most qualified for the CHP system, PROLIGNIS has conducted an assessment study, analyzing the availability of feedstock in the proximity of the CHP in terms of quantity and quality, cost of material, reliability of supply and overall environmental and social sustainability, among others. As a result, it was suggested that untreated wooden biomass material in the form of wood chips is the most suitable material and shall be utilized as primary source of feedstock. To balance future feedstock supply risks rice husk may be blended with wood chips at a later stage.

Wood chips production in Vietnam has developed fast over the last decade mainly driven by a growing global demand of wood chips for energy and fiber production. As a result, Vietnam's export volumes of wood chips have increased from 400,000 tons in 2001 to over 6.2 M tons in 2012 (Forest-Trends 2012) representing 20% of the global wood chip trade. Currently over 70% of the timber harvested from plantations is utilized for wood chips. The rapid expansion of wood chip production for export has led to shortages of raw material domestically which in turn has prompted many FMUs, contractors and smallholder plantation owners to set up and manage plantations inefficiently, paying little to no attention to sustainable forest management causing an overexploitation of plantation forest, illegal land use and social conflicts. Consequently, purchasing wood chips in Vietnam bears sustainability risks and needs to be addressed at an early stage of designing a sustainable wooden biomass feedstock supply chain for a CHP. PROLIGNIS is aware of the sustainability risks associated with a wood chips supply chain and therefore plans to sign up long term purchase orders for wood chips or wooden raw material directly with FMU forest producer or contractors with good and reliable track record of sound management and business practices. Alternatively, PROLIGNIS also considers to invest directly into plantation forests to be able to manage and control the risk of a sustainable supply chain. To support PROLIGNIS in its efforts to design and manage a sustainable wood chips supply chain from plantations, the German Consulting company FOREST FINEST CONSULTING (FFC) - an experienced forest management consulting with a local branch office in Hanoi - was hired to source for suitable plantation land

within a radius of 80-100 km of the CHP and to provide advisory on the establishment and management of plantations and handling of wooden material to mitigate potential sustainability risks of the supply chain.

Major elements to be considered for designing a sustainable wood chips supply chain based on plantation wood are:

Reliable and long-term delivery of high quality wood chips to the CHP plant.

With a designed firing capacity of 13 MW over 8,000 hours per year the total fuel demand for the CHP system would be approx. 104,000 MWh/year. Using wood chips from acacia plantation with a LHV of 3.4 kWh/kg (moisture content 30%) the total consumption of wood chips would amount to around 31,500 tons per year or 95 tons daily.

Table 17: Wood chips consumption of the CHP conversion system

Item	Data	Unit
Firing capacity	13	MW
Operating hours	8,000	hours/year
Fuel demand	104,000	MWh/year
LHV of wood chips at 30% moisture content	3.4	kWh/kg
Wood chips consumption	31,515	tons/year

Source: own calculation based on data from Prolignis 2016,

Based on the annual amount of 31,500 tons of wood chips consumed by the CHP and assuming an average productivity of the plantation of 30 m³/ha and year (according to FFC) with a 7-year rotation (6 years growing period + 1 year harvest) and a potential harvesting rate of wooden material to be utilized for wood chips production of 100%, 60% and 40%, a total plantation area of about 1,200, 2,000 and 3,000 ha respectively, is required to meet the wood chips demand for the CHP plant (see table 18) to ensure a reliable supply over the year.

Table 18: Plantation area for wood fuel production

Item	Data	Unit
Rotation period	7.00	Years
Plantation yield (fresh) 50% M	30.00	m ³ /ha/year
Conversion factor volume to mass	0.85	%
Plantation yield (fresh) M 50%	25.50	tons/ha/year
Plantation yield (fresh) M 50%	153.00	tons/ha/rotation
Plantation yield M 30%	20.40	tons/ha/year
Size of plantation if 100% harvest for wood chips	1,200	Ha
Size of plantation if 60% harvest for wood chips	2,000	Ha
Size of plantation if 40% harvest for wood chips	3,000	Ha

Source: own calculation based on data from Forest Finest Consulting (FFC)

Beside the rotation period, the harvesting rate of a plantation for wood chips production is a decisive factor to determine the plantation area required to meet the demand for wood fuel which depends largely on the specific site conditions of the plantation, including soil and water conditions, terrain, climate, management capacity of the FMU and the opportunity costs for alternative timber usage. In general, timber production as quality wood for material utilization (i.e. furniture) adds higher value to the resource and should be the preferred way of usage for plantation wood. For wood chips production usually timber-harvesting residues, including left-over wooden material from thinning and trimming, is being recovered and can range between 40-60% of the total amount of wood recovered. Vietnam has a record of natural calamities from draughts and hurricanes to pests which can affect the supply chain of wood chips leading to temporary shortage of wooden feedstock material posing additional risks towards managing a reliable and constant supply of wood chips. Precautionary measures need to be integrated in the supply chain such as extra storage capacity to balance such threats or alternative procurement arrangements for additional wooden material or other biomass fuels to serve as a buffer capacity.

Cost of wood chips

Being a newcomer in the biomass power market in Vietnam with limited experience of the wood chips market and related mechanism of price setting, PROLIGINS plans to partner with FFC for designing and managing the wood fuel supply chain for the CHP. The pricing would be handled transparently based on the production costs of wood chips to the CHP plant, as determined by the production and handling costs including plantation management, harvesting, pre-processing, transportation and storage. Depending on the prevailing specific local conditions of the plantation site which have yet to be finalized, the production and handling cost of wood chips delivered to the CHP site are estimated by FFC to range between USD 40-60/ton fresh basis (moisture content approx.

50%). The estimated costs are based on sustainable forest management practices complying with FSC or PEFC management standards but exclude direct certification costs such as auditing, capacity development and associated certification fees. Depending on the size of the plantation area, the terrain and management capacity of the FMU, direct certification cost for FM and CoC pre-certification and ongoing verification vary and range between around USD 20,000 – 30,000 per year. Assuming an average cost of USD 25,000 per year for the PROLIGNIS CHP case, the unit cost of feedstock would increase by about 0.75-1.5% or USD 0.4-1.0/ton.

Environmental and social sustainability

Environmental and social sustainability of the supply chain directly impacts the overall sustainability of the CHP and is a key requirement for PROLIGNIS. Being aware of the current practices to manage plantation for wood chips production in Vietnam which is often lacking environmental and social sustainability, PROLIGNIS plans to design and implement the supply chain along the FM and CoC standards as defined by FSC and PEFC. In terms of environmental sustainability, the rotation period and the harvesting rate of a plantation impacts the sustainability. Since PROLIGNIS plans not to be directly engaged in the production and handling of the wood chips supply chain, a decision among the key stakeholders (PROLIGNIS, FFC) on how to arrange for the certification process and the procurement of certified wood chips has not been reached.

GHG emission

A wood chips fuel supply chain from plantation comprises GHG emissions during all stages of the supply chain. Major sources of GHG emission are land use change and consumption of fossil fuels for harvesting, processing and transportation. Since wood chips are of a bulky nature with a relatively low energy density, transportation can be a major factor contributing to GHG emissions of the supply chain. Short transportation distances, pre-drying and pre-processing of the wooden biomass material are effective ways to lower the GHG emission. Plantation land if established on marginal land with sparse vegetation and sustainable management mitigates GHG emission through carbon storage and sequestration. Wood chips from FM and CoC certified plantation wood ensure a high degree of climate change mitigation. FM and CoC certification schemes however do not allow for accounting of emissions reductions. For that, different certification standards are available designed to measure, report and verify GHG emission reduction, which may add additional value to the project. The Gold Standard Foundation (GSF)⁸ for example, has developed different standards to certify environmental (primarily GHG reductions) and sustainable development impacts from activities developed in the energy, waste, land use & forestry and water sectors. GS recently announced its new GS 3.0 standard⁹ which would allow for a comprehensive GHG certification approach along the bioenergy value chain, from the forest to the CHP conversion system.

Table 19: Potential CER yield and revenue from GHG emission certification

Potential CER yield and revenue	Plantation area (100, 60, 40% harvesting rate)		
	1,200 ha	2,000 ha	3,000 ha
CERs from plantation over 30 years	120,168	200,281	300,421
CER from plantation per year	4,006	6,676	10,014
CER from CHP system	14,300	14,300	14,300
CER from plantation and CHP per year	18,306	20,976	24,314
Annual revenue from CER sale at USD 4 per CER	73,222	83,904	97,256
Total revenue from CER sale over 30 years	2,196,674	2,517,123	2,917,685

Source: own calculation based on data from Forest Finest Consulting (FFC)

According to FFC, a plantation forest if sustainably established and managed could generate approximately 100 tons CO₂e/ha over a cultivation period of around 30 years. At the same time the CHP plant, as stated by PROLIGNIS, could generate approx. 14,000 CERs per year. Depending on the harvesting at a rate of 100%, 60% or 40% of plantation land for feedstock supply, a total carbon emission reduction from plantation management and CHP conversion of 18,300, 21,000 and 24,300 tons/year respectively could be realized. Assuming a sale price of 4 USD/CER on the voluntary market, an additional revenue of 73,000, 84,000 and 97,200 USD/year could be generated. With a cost for the development and operation of GHG emission certification ranging between 1.70–2.50 USD per ton CO₂ depending on the total plantation area and management capacity of the FMU and CHP plant operator, a considerable financial benefit through the sale of certified carbon emissions could potentially be achieved. Though carbon markets are still slow, with prices ranging between 1-7 USD/CER in 2015 it is expected that due to the newly adopted Paris agreement carbon market activities will regain momentum, leading to more dynamic and stable market conditions with a tendency to higher pricing (Forest Trends' Ecosystem Marketplace).

⁸ <http://www.goldstandard.org/>

⁹ <http://www.goldstandard.org/articles/gold-standard-30>

5.2.1.2 The supply chain business model

PROLIGNIS has decided to use untreated and sustainably produced wood chips from plantation land as the primary source of feedstock. For the production and handling of the feedstock material along the supply chain, PROLIGNIS plans to partner with the German forest management company FFC. In principal two business models are currently being considered to manage the supply chain, (1) PROLIGNIS in partnership with FFC invests into plantation land and handles all stages of the supply chain independently or (2) PROLIGNIS in partnership with FFC signs up with one or several plantation companies for the procurement of feedstock. In table 20 below, the advantages (Pros) and disadvantages (Cons) of both models are briefly described.

Table 20: Supply chain business model

Supply chain business model	Pros	Cons
I. PROLIGNIS in partnership with FFC invests into plantation land and handles all stages of the supply chain independently	<ul style="list-style-type: none"> - Find plantation land in proximity of CHP plant - Ability to control all stages of the supply chain and manage risks accordingly - Ability to management supply chain more efficiently - Produce high quality feedstock according to CHP requirements - Stable long term pricing/costing secured - Low sustainability risk due to own FM certification - Ability for new business opportunities in the forestry sector (i.e. timber) - Allow for integrated FM and GHG certification to account for CERS - CHP approval process easier - Increased reputation towards sustainable bioenergy business due to stronger commitment 	<ul style="list-style-type: none"> - High investment and long term binding of capital - Time consuming to find adequate plantation land and setting up plantations - First harvest only after 7 years - Intermediate feedstock suppliers needed to bridge supply - CoC certification only for bridging time - Bureaucratic hurdles - Need to bridge supply until first harvest from own plantations - Not familiar with plantation business - Need to build up new management capacities in plantation business - Less flexible on using alternative feedstock material - More exposed to political uncertainties
II. PROLIGNIS in partnership with FFC signs up with one or several plantation companies for the procurement of feedstock	<ul style="list-style-type: none"> - Less capital risks as no investment in plantations needed - Feedstock material immediately available - Focus on core CHP business 	<ul style="list-style-type: none"> - Existing plantation in proximity of CHP plant not available - Risk of higher price/cost of feedstock - Increased dependency on third party - More effort needed to control the supply chain - Less possibility to change management - CoC certification needed to prove sustainability of feedstock

Both business models are suitable to ensure a sustainable feedstock supply chain, whereby the plantation investment model has the advantage of being able to better manage and control a reliable and steady supply of feedstock of high quality on long-term basis under predictable price conditions. A disadvantage, however would be the time delay in the production of wooden material due to the time needed to source for adequate plantation land, setting up the plantation and to initial harvesting. From the sustainability point of view, more efforts towards risk management would be needed for the contracting model, for which CoC certification would be needed to ensure full compliance with the certification standards. A combination of both models – investing and contracting - seem to be the most feasible way to design and manage the supply chain, balancing the risk of high capital investment for plantation land and controlling a sustainable feedstock supply under predictable economic conditions.

Since there is no CHP project yet developed and operating in Vietnam feeding on wooden biomass material, the PROLIGNIS project may be considered as a pilot project to demonstrate the benefits of using wooden biomass material in a sustainable way. Looking at the huge potential of wooden biomass from plantation in Vietnam which currently is mainly utilized for wood chips production for export the project may serve as case study to review concerned policies and regulations towards a promotion of wooden biomass material for heat and power generation. Since the use of wooden material for energy purposes is being discussed controversially and can easily have adverse effects to the environment, social and climate change, projects need to be developed at the highest sustainability level to ensure full compliance with internationally recognized standards thus to stimulate broad recognition among policy makers and the public.

6 Conclusion

With the objective to provide guidance for the analysis of risks along the supply chain, for the assessment of which certification scheme best addresses these risks, and to get a first understanding of both the costs and benefits of sustainability, the following conclusions can be drawn:

1. Wooden biomass material is a valuable resource for bioenergy conversion which provides a large potential for the expansion of the bioenergy sector. Sources of wooden biomass include trees from designated plantation and forest land, as well as residual material from timber harvesting or wood processing.
2. With a forest area of about 14 M ha (10 M of natural forest and 4 M hectares of plantations) producing over 17 M m³ of timber annually, and a fast growing wood processing industry generating vast amounts of wood residues, Vietnam is rich in wooden biomass resources. Those resources can potentially be recovered for heat and power generation, contributing to the achievement of the national targets for renewable energy, thus enhancing energy security, fossil fuel replacement and GHG emission mitigation. Up to now however, woody biomass is not being utilized systematically and efficiently for energy purposes, including for CHP conversion. That is on the one hand because of insufficient legal framework conditions and incentive policies to stimulate investment into solid biomass based CHP systems. On the other hand the supply of wooden biomass as feedstock for heat and power generation is in strong competition with the largely export-oriented wood chips industry which uses 70 % of all the timber harvested from plantation forests for wood chips production to be exported as raw material, mainly for pulp and paper and power generation. Similarly, left-overs from wood processing are almost entirely purchased for further processing to wood pellets, destined for export. As a consequence, plantations are frequently managed inefficiently and unsustainable, with short (3-4 years) rotation cycles, monocultures, as well as uncontrolled and conflicting land use changes, which pose high sustainability risks to the plantation sector.
3. Since 2013, the Vietnamese government, under the forestry sector reform program, has adopted policies and support mechanisms directed towards developing a forestry sector that is economically, socially and environmentally more sustainable. The reform encompasses a gradual shift from a solely export-oriented wood chips production towards an integrated approach to promote improved quality, efficiency and competitiveness both at forest management and material utilization level. Yet, the use of wooden biomass for energy utilization as a strategic element of an integrated sustainable forest and energy development is not addressed on national policy level, thus compromising the opportunity to tap the synergies arising from sustainable forest management and bioenergy development as a climate friendly and ecologically and socially responsible development approach.
4. Like for any form of wood utilization, the use of wooden biomass material as feedstock for bioenergy conversion potentially bears considerable risk in terms of environmental and social sustainability and can easily lead to the destruction of forest land or change of land use, with adverse effects on soil and water, biodiversity, GHG emissions, land ownership etc. In western countries including Europe and North-America, where wooden biomass contributes largely to the generation of heat and power, sustainability issues are of high concern which has resulted in a number of initiatives, standards, guidelines and legal regulations, to safeguard sustainability to a larger extent. Although Vietnam has put forth a variety of legal provisions and guidelines to regulate the sustainable production and handling of forest products, illegal logging, land tenure conflicts, unsustainable forest management and handling are still frequently observed and constitute a high sustainability risk. FM and CoC certification addresses these risks and assures a high standard of sustainability both on forest and on supply chain level. In Vietnam, certification is mainly used to reach out to dedicated export markets e.g. to Europe or the U.S. yet FM certification is still not widely applied. Currently, just slightly over 1% of the total forest land is certified, mainly due to its complexity, lack of capacity and uncertainty in regards to costs and return on investments in certification. This situation may change with the introduction of a national certification scheme which is currently being developed in cooperation with PEFC, targeting an area of 500,000 ha to be certified by 2020.
5. Designing and implementing a wood fuel supply chain for CHP in Vietnam is challenging and bears risks all along the chain, from sourcing and production of the raw material to the delivery of processed feedstock to CHP. Foremost, a lack of reliable data on the forestry sector aggravates the sourcing process and may lead to wrong assumptions on the actual availability of wooden biomass material, thus affecting the overall feasibility. A further risk poses the licensing and

approval process which due to complex bureaucratic structures and in-transparent decision-making at national and provincial level may be time-consuming and unpredictable. As a result of the highly competitive wood chips sector, purchasing feedstock material from unknown contractors may bear a high risk of obtaining unsustainable wood fuel material. A thorough due diligence of the supplier or purchasing only from certified wood chips suppliers may prevent such risk. Overall, a comprehensive understanding of the prevailing local conditions in the forestry sector and a well-established relationship with the key actors involved is crucial towards designing and managing a sustainable supply chain. Seeking external advice from forest management consultants with in-depth knowledge and experience on plantation management and feedstock handling may be a viable way to manage risks along the supply chain.

6. Since there is no CHP project yet developed and operating in Vietnam feeding on wooden biomass material, the PROLIGNIS project may be considered as a pilot project to demonstrate the benefits of using wooden biomass material in a sustainable way. Looking at the huge potential of wooden biomass from plantation in Vietnam which currently is underutilized for wood chips production for export, the project may serve as a case study to review and adopt policies and regulations towards the promotion of wooden biomass material for heat and power generation. Since the use of wooden material for energy purposes is being discussed controversially and easily affects the ecological and social sustainability as well as climate change, CHP projects in Vietnam are to be developed at the highest sustainability level to ensure full compliance with internationally recognized standards, thus stimulating a broad recognition for wood fuel based CHP among policy makers, financing institutions and the public in general.

Appendix

List of Interviewees

- Binh Duong Furniture Association (BIFA)/ Hiep Long Fine Furniture Company: Huynh Quang Thanh
- Forest Finance: Ms. Dung Mai, Mr. Andreas Schnall
- Forest Stewardship Council (FSC), Asia Pacific: Ms. Que Anh Vu
- General Directorate of Energy (GDE): Mr. Nguyen Ninh Hai
- GIZ Vietnam, “Conservation and sustainable use of forest biodiversity and ecosystem services”: Ms. Kirsten Hegener, Mr. Dominic Stanculescu
- GIZ Vietnam, NAMA: Ms. Anna Schreyoegg
- GreenID: Ms. Cam Nhung, Mr. Lars Blume
- Handicraft and Wood Industry Association of Ho Chi Minh City (HAWA)
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