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MEMORANDUM

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CC: Wendy B. Jacobs & Shaun A. Goho

DATE: May 14, 2015

RE: Comparison of Wood Pellet Technical Specifications and Certification Schemes

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I. INTRODUCTION

This memorandum reviews the technical specifications and certification schemes for wood pellets implemented and administered by five institutions:

i. the Pellet Fuels Institute ("PFI") which administers the PFI Standard Specification for Residential/Commercial Densified Fuel ("PFI Standard Specification");
ii. the European Biomass Association ("AEBIOM") and the European Pellet Council ("EPC") which administer the ENplus system ("ENplus");
iii. the Wood Pellet Association of Canada ("WPAC") which administers the CANplus system ("CANplus");
iv. DIN CERTCO which administers the DINplus standards ("DINplus") and the DIN Geprüft standards for industrial pellets ("DIN Geprüft"); and
v. the Bionergy Association of New Zealand ("BANZ") which administers the Wood Fuel Classification Guidelines ("BANZ Guidelines").

Compliance with these technical standards is usually ensured through certification schemes whereby certificate holders are permitted to use a label mark belonging to an institute if the pellets in concern adhere to the technical specifications and other requirements imposed by the institute. The certification schemes for PFI, ENplus, CANplus and DINplus are discussed in a separate paper.

II. KEY SIMILARITIES AND DIFFERENCES

The technical specifications and operation of the four certification schemes are described in detail below. This section summarizes the key similarities and differences among them.

A. Similarities

Technical Standards: All of the schemes distinguish between wood pellets for residential use and commercial use, imposing stricter requirements on the former. All of the standards address the types of raw materials and additives which may be used. Finally, they lay down several

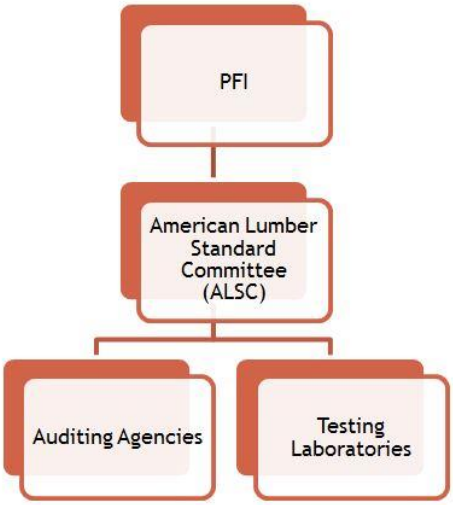
specifications of the wood pellet which must be met—this includes characteristics such as size, moisture and ash content, mechanical durability, bulk density, permitted percentage of additives, and chlorine and nitrogen content. These quantitative requirements are fairly similar among all the schemes.

Hierarchical Implementation and Enforcement: All four schemes have a main body that issues certifications and administers the system. PFI and AEBIOM, being larger systems, go one step further by appointing an independent party to implement and enforce the system. Under the PFI system, the American Lumber Standard Committee is the appointed accreditation body, while under the ENplus system, the EPC or a National Licenser handles implementation and enforcement. Under the ENplus system, producers and traders can choose to apply to either the EPC or the National Licenser in their geographic area for certification. The reason for this structure is that the ENplus system is a multinational effort; it was essential to allow European countries to manage their own domestic certification. In fact, this flexibility to allow National Licensers to administer the certification process enabled WPAC to become the National Licenser of the ENplus system in Canada and issue the CANplus certification mark.

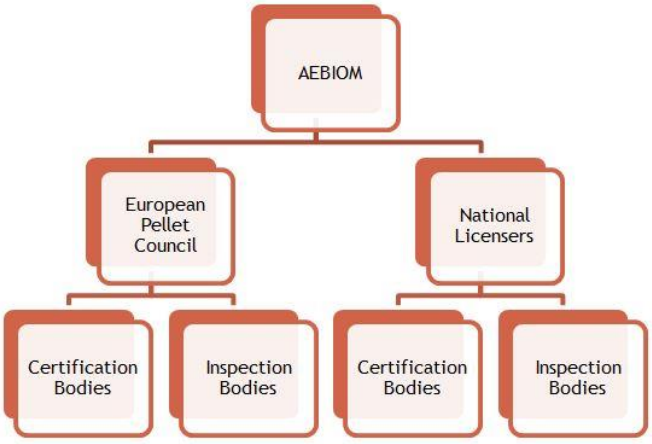
In each of these systems, the accreditation body or appointed authority authorizes one or more accredited audit or inspection agencies to carry out the certification of the respective systems. Another similar feature is that independent testing laboratories will also be accredited to carry out testing of samples taken by the auditing agencies. This additional tier creates more independence and allows for an extra layer of independent scrutiny. Testing laboratories provide test reports to auditing agencies which consider the report alongside the applicant's application and other relevant documentation in deciding whether or not to grant certification. Upon granting certification, both the audit agency as well as the initial accreditation body will continuously monitor the certificate holder through various inspections as well as require the certificate holder to have a robust internal monitoring system for purposes of quality assurance.

Despite giving the rights to independent accreditation bodies or appointed authorities, the main bodies like PFI and AEBIOM still play an important role, because they control the product specifications, with which the accreditation body, auditing agency, testing laboratory and certificate holder will have to comply. Further, the licensing agreement between the main body and the accreditation body, and between the accreditation body and auditing agencies and testing laboratories always ensure that the upper tier will always maintain supervisory authority over the lower tier through a top-down approach.

The following diagrams exhibit the structure of the PFI and ENplus certification schemes.



PFI Qualification Process



EN plus Certification Process

Enforcement: Where a non- compliance is detected, the most severe consequence that could occur is the revocation of the certificate and the prohibiting of future use of the certification mark on labels. There are no financial penalties or retrospective consequences.

B. Differences

Technical Standards: As set forth in detail in the table in Annex II, below, the pellet standards also differ in several ways. First, the schemes differ in the types of raw materials that can be used to manufacture pellets. Under the PFI system, manufacturers are allowed to use hard wood, soft wood, mixed hard wood and soft wood, agricultural grasses, and nutshells as material, whereas ENplus and DINplus only allow stem wood and chemically untreated residues from the wood processing industry for its highest standard grade. ENplus and DINplus also prohibit the use of chemically treated wood (with the exception of wood treated for insect attack) and construction and demolition wood. On the other hand, although PFI and BANZ prohibit the use of chemically treated wood, they permit the use of construction and demolition wood if certain procedures are followed. However, as PFI has not identified such a procedure to date, construction and demolition wood may not be used under that scheme at the present time. In terms of the minimum requirements imposed by EPA, it is significant to note that demolition and construction wood is absolutely prohibited, as well as lawn clippings or yard waste.

Second, the schemes have different requirements for wood pellet composition and conformation. Both ENplus and DINplus have set standards for net calorific value as well as for the content of nitrogen and sulphur, and trace metals such as arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. PFI does not set any standards for these categories. This is especially important because EPA's minimum requirements set a limit for trace metal content.

Frequency of Audits: PFI requires accredited auditing agencies to carry out monthly inspections of qualified manufacturers. The other certification schemes only require annual audits. The expenses for these audits are covered under the annual fees for the certification. However, where additional audits are required in cases of complaints of non-compliance, the facility being subjected to such audit could be made responsible for expenses relating to the audit.

Covered Entities: Another difference is in the portions of the supply chain covered by the certification scheme. The PFI system only covers the manufacturers and not dealers or traders

(who provide interim storage pending distribution of the pellets), or forwarders (who solely provide transportation of the pellets). In this respect, ENplus and DINplus are more comprehensive and allows for dealers and transporters to apply for certification as well. In fact, the DIN CERTCO goes one step further to distinguish between producers and dealers/forwarders and administers separate certification schemes for them—the DINplus for wood pellet producers and the DIN-Geprüfter Fachbetrieb Certification Scheme for dealers and forwarders. It is important to extend the certification coverage beyond producers of pellets to include dealers and transporters of pellets as post-production storage condition could expose pellets to moisture and other contaminants which would reduce the quality of the pellets.

Sustainability Requirements: Finally, it should be noted that only ENplus has incorporated sustainability requirements in its system. ENplus-certified producers are required to sign a Statement of Commitment to ensure that both the sourcing of raw materials for their pellets and the operation of their pellet plant complies with generally accepted sustainability principles. Furthermore, pellet producers must also record the carbon footprint of their pellet production. While other systems require producers to state the source and type of the raw materials that have been used, they do not have a similar requirement like the one under the ENplus system. Despite that, ENplus stops short of ensuring full traceability of wood sources that are used in the pellet production process. Nevertheless, there are several independent sustainability schemes which ensure full traceability of wood source origin and impose annual audits on producers. These independent sustainability schemes will be discussed further in Annex I.

Thus, as can be observed from above, the key differences between PFI and ENplus can be divided into three categories: (1) frequency of audits; (2) scheme coverage; and (3) sustainability. Based on the above, it can be summarized that to ensure the quality of wood pellets, ENplus relies primarily on clean material going into the production mill; whereas PFI relies to a greater extent on frequent testing of pellets coming out from the production mill.

III. THE STANDARDS

A. PFI

1. Background Information and Coverage

There are three pertinent documents to understand the PFI system: (1) the PFI Residential/Commercial Densified Fuel QA/QC Handbook (the "QA/QC Handbook"),[1] (2) the PFI North American Grading and Quality Management System for Residential/Commercial Densified Fuel (the "Grading and QMS manual"),[2] and (3) the American Lumber Standard Committee ("ALSC") Residential/Commercial Densified Fuel Enforcement Regulation (the "ALSC Enforcement Regulations").[3]

The purpose of the QA/QC Handbook is to provide quality control and assurance procedures for the production of graded residential/commercial densified fuels. It details the minimum

[1] *See* Pellet Fuels Institute, *PFI Residential/Commercial Densified Fuel QA/QC Handbook* (2011), *available at* http://www.pelletheat.org/assets/docs/qa-qc-handbook-november-2011.pdf.

[2] *See* Pellet Fuels Institute, *PFI North American Grading and Quality Management System for Residential/Commercial Densified Fuel* (2011), *available at* www.pelletheat.org/assets/docs/pfi-na-grading-and-q-mgmt-november-2011img.pdf.

[3] American Lumber Standard Committee Inc, *Residential/Commercial Densified Fuel Enforcement Regulations* (2013), *available at* www.alsc.org/greenbook%20collection/Pellets_EnfRegs.pdf.

requirements for qualified production facilities that produce wood pellets in accordance with PFI standards. The Grading and QMS manual is essentially a supplemental reference tool to the QA/QC Handbook.[4] The purpose of the ALSC Enforcement Regulations is to specify the enforcement aspects of the certification scheme.

The PFI certification scheme only applies to pellet manufacturers. It does not provide any form of certification for traders or transporters of pellets.

2. Grades

The PFI Standard document establishes three different fuel grades—PFI Premium, PFI Standard and PFI Utility.[5] To determine the fuel grade, all properties must fall within the specified limits listed for the particular grade. A fuel which fails to meet any fuel property of a particular standard will not automatically qualify for the lower grade—it would have to meet all requirements of the lower grade to fall in that category. The quantitative standards for each PFI grade will be produced later in this paper.

3. Technical Specifications—What is Required and What is Prohibited

At paragraph 1.2, the following properties are described as mandatory for determining fuel quality grade: fines, bulk density, diameter, length, heating value, chloride, moisture content, pellet durability index, and inorganic ash content. Excluded from the mandatory list is ash fusion which is categorized as informative fuel property. The types of materials used as well as the types of additives that are added (if any) must be disclosed.[6] The types of materials that may be used include: hard wood, soft wood, mixed hard wood and soft wood, agricultural grasses, and nutshells. While chemically treated materials are prohibited,[7] the use of construction waste debris is acceptable provided certain procedures are adopted.[8]

4. Overview of Certification Process

As provided for under section 4.1 of the Grading and QMS manual, the certification process is as follows:

1. PFI enters into an agreement with an accreditation body ("AB") to provide independent oversight of the program. The ALSC has been appointed at the AB for the PFI system.
2. The AB accredits auditing agencies ("AA") and testing laboratories ("TL") through enforcement regulations.
3. AAs inspect production facilities, while TLs provide independent third party testing for samples collected by AAs.
4. AAs enter into agreements with production facilities that are found to be in compliance.

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[4] Pellet Fuel Institute, *PFI Standards Program*, http://www.pelletheat.org/pfi-standards-program, last visited May 7, 2015.

[5] *See id.*, Table 1.

[6] Pellet Fuels Institute, *PFI Residential/Commercial Densified Fuel QA/QC Handbook*, at § 8, *available at* http://www.pelletheat.org/assets/docs/qa-qc-handbook-november-2011.pdf. The additives may not exceed 2% of total weight.

[7] *Id.*, § 4.5

[8] *Id.*, § 6.7. As provided under Article 6.7, construction waste debris may only be used if the materials are verified to be cleaned in accordance with Annex A. Note: the content of Annex A is yet to be determined.

5. Production facilities are continuously monitored by AAs, while AAs and TLs are continuously monitored by the AB.
6. PFI maintains a web-based registry of the AB, AAs, TLs and certified production facilities. Accreditation, qualifications, and/or registrations may be revoked in cases of non-compliance.

The certification process is further detailed in the QA/QC Handbook. Section 5 of the QA/QC Handbook requires the production facility to identify the particular grade (or grades) intended for production (namely Premium, Standard and Utility). Section 6.1 requires all facilities intending to be certified by PFI to develop a written quality management program which is to be approved by an AA. The purpose of this document is to ensure that the production process is monitored and verified through testing and auditing. The quality management program should include the following components: (a) determining responsibility throughout the organization, (b) employee training, (c) proper documentation and record keeping, (d) controlling the quality of raw materials, (e) defining the operating, quality control and assurance processes, (f) third party inspection and monitoring, (g) corrective methods, and (h) requirements for labelling as well as packing, storage, handling, transport and delivery.

Section 6.2 requires the management of each production facility to ensure performance and monitor all activity to meet the quality standards. To achieve this, an employee must be appointed as quality manager. Further, all involved employees must undergo quality training at least once a year. The quality manager must ensure the proper documentation of matters identified in section 6.4, which include details on raw materials, the production process, quality verification of the product, periodic inspection of equipment and storage facilities, as well as customer complaints. All such information is to be recorded and shall be made available for internal or external audit (section 6.5).

With respect to the storage, handling, and delivery of the pellets, in accordance with section 6.14 the production facility must ensure that the pellets must not be exposed to moisture through contact with water, rain, or snow, all equipment and storage facilities must be regularly inspected to eliminate contamination, and non-qualifying pellets do not mix with quality marked pellets. If pellets of one grade co-mingle with another grade, they must be quality marked to the lowest grade present.

5. Third Party Audits

Section 6.10 requires all production facilities to submit to third party audits which are to be carried out according to the PFI Residential Densified Fuel Enforcement Regulations.[9] These third party audits are to be performed on a monthly basis and random samples are to be taken for testing. If a production facility demonstrates over time that it is complying with the standards and that it has an effective of internal quality management system in place, then the frequency of the audits can be reduced.[10] Section 6.11 stipulates that a facility is considered to be compliant with a PFI grade if 95% of the samples taken during an audit meet the specifications for that grade.

[9] This is now covered under the ALSC Enforcement Regulation as the ALSC has been appointed by PFI as the Accreditation Body.

[10] Provisions for reduced audits and sample collection will be developed by PFI when participants have demonstrated compliance.

6. Certification

Section 7 describes the process for obtaining certification. The prospective production facility must enter into an agreement with an AA and complete an application form. Upon processing the application, the AA will carry out an initial audit of the production facility to verify conformity with the PFI Standard Specifications, the QA/QC Handbook, and the facility's own written quality management system. Once the production facility is found to be in compliance, a qualification document will be issued to the facility. A qualified facility will be subject to external monitoring in accordance with the ALSC Enforcement Regulations which entails an initial audit and periodical audits thereafter. Finally, as provided under Section 8, once a production facility receives its qualification from an AA, the facility acquires the right to use a PFI Quality Mark on its label which must be displayed on the bag and include details of the pellet grade and specifications as well as details of the auditing agency.

7. Enforcement

In accordance with the QA/QC Handbook and the Grading and QMS manual, PFI appointed ALSC as the AB to implement and enforce the PFI program; ALSC in turn issued the ALSC Enforcement Regulations.[11] As provided under section 4.3.7, the pellet manufacturer shall be inspected a minimum of twelve times per year at approximately monthly intervals. Quality marks that are issued to pellet manufacturers may be withdrawn when an inspection or series of inspection reveal serious non-conformances (section 4.7.1.). The agency may reinstate the quality mark after the manufacturer has taken corrective steps to comply. As provided under section 4.8, a buyer of pellets may request for reinspection of the pellets if it believes that the pellets being sold are not in compliance.

Section 4.11.1 authorizes the Board of Review of the ALSC to examine any product certified by an AA for purposes of determining the performance of the agency, its inspectors and the general reliability of its service. The ALSC is also authorized to conduct random sampling checks of pellets produced by qualified manufacturers. AAs are required to follow up on problems identified in such random ALSC auditing and sampling by carrying out a reinspection of the manufacturer pursuant to section 4.13.2. If the Board of Review is not satisfied with the performance of an AA, it may do one of the following under section 4.15.1: take no action, place the agency on probation, suspend it, or revoke its authority to act as an AA. Before the Board of Review makes a decision to take any of these actions, it must notify the AA and provide it an oral hearing before the Board of Review.

The accreditation of testing laboratories is provided for under section 6. As provided under section 6.1.3, the Board of Review is entitled to visit testing laboratories unannounced during working hours to inspect the laboratory and its records. Laboratories are required to carry out periodic internal inspections of their equipment. After completing its testing, the accredited laboratory is required to issue test reports detailing the results of the test, particularly the identification of specifications and grade of the pellets. Any laboratory is permitted to submit an application pursuant to the process stated in section 6.11. The Board of Review will evaluate the application and decide whether to grant or deny accreditation (section 6.12). In the case of denying (or subsequently revoking) accreditation, an oral hearing must be granted to the laboratory (section 6.13).

[11] *Id.*; *see also* American Lumber Standard Committee Inc., *Pellet Program Enforcement Regulations*, http://www.alsc.org/pellet_pfi_mod.htm, last visited May 7, 2015.

B. ENplus

1. Background Information and Coverage

The ENplus system was first introduced in Germany in 2010 and is now used all over Europe, as well as in Canada and the United States which produce a substantial amount of ENplus pellets for export to Europe.[12] It is currently administered by AEBIOM and the EPC. The ENplus Handbook expresses that its goal is to secure high quality wood pellets throughout the supply chain by controlling production as well as logistics and delivery.[13] The ENplus scheme offers separate certifications for both manufacturers of pellets and dealers in pellets.

2. Grades

Part 2.1 of the ENplus Handbook creates three classes of pellet quality which can be distinguished based on the raw materials that are used as well as the characteristics of the wood pellet. They are: ENplus-A1, ENplus A-2, and EN-B. Detailed characteristics of the wood pellet standards based on their respective classifications are included in the table at the end of this paper.

3. Technical Specifications—What is Required and What is Prohibited

As for the type of wood that may be used as raw material for the production of wood pellets, Part 2.2 of the ENplus Handbook expressly prohibits the use of chemically treated wood with the exception of wood externally treated with wood preservation against insect attack. It also prohibits the use of demolition wood which is defined therein as "*wood coming from the demolition of buildings or civil engineering installations*." Wood types that are permitted to be used for wood pellet production are:

i. ENplus-A1: Stem wood; chemically untreated residues from the wood processing industry.
ii. ENplus-A2: Whole trees without roots; stem wood; logging residues; bark; chemically untreated by-products and residues from the wood processing industry.
iii. EN-B: Forest, plantation and other virgin wood; chemically untreated by-products and residues from the wood processing industry; chemically untreated used wood.

As for the use of additives (which is defined as materials, such as starch, corn flour, potato flour, and vegetable oil, intentionally introduced into the pellet production or post-production to enhance fuel quality, reduce emissions or increase efficiency), Part 2.3 allows for additives up to a maximum of 2% of the total mass of the pellets.[14] Water, steam and heat are not considered to be additives. The type and quantity of all additives have to be documented. Further, additives must originate from processed or unaltered farming and forestry products. Finally, particular additives that may cause problems in heating devises or pose health or environmental risks may be excluded by EPC. Producers that intend to use a new additive must satisfy EPC that the additive is both beneficial and harmless.

[12] ENplus website, http://www.enplus-pellets.eu, last visited May 7, 2015.

[13] European Pellet Commision, *ENplus Handbook*, *Version 2.0*, at 3 (2013), *available at* www.enplus-pellets.eu/wp-content/uploads/2012/01/ENplus-Handbook-2.0.pdf.

[14] Additives introduced in production are limited to 1.8 w-% while additives post production are limited to 0.2 w-% of the total mass of the pellets.

4. Overview of Certification Process

The certification process (see section 3.1 of Handbook) can be outlined as follows. An interested pellet producer or trader has to apply to the EPC or National Licenser for a license. The ENplus scheme allows for either the EPC or National Licensers[15] to issue licenses to pellet producers or traders that allow them to use the ENplus trademark. National Licensers may authorize one or more certification bodies to operate the licensing procedure in the country but may not assign or transfer the licensing right to them (this is known as third party certification). The use of certification bodies is to ensure independence of the certification scheme.

Where an application is made to the EPC, the applicant will choose a listed certification body and a listed inspection body. If the application is made to National Licenser, the applicant will have to choose a certification body and listed inspection body for his country. The certification body is tasked to review the application and to determine if it conforms with the ENplus Handbook as well as consider the inspection report (for pellet producers). If the application is approved by the certification body, it will submit a conformity report to the applicant and the EPC or National Licenser (as the case may be). The EPC or National Licenser will then send the licensing contract to the applicant, and upon the applicant's payment of the license fee, the EPC or National Licenser will notify the certification body to send the certification document to the applicant.

The validity of the certification is explained in section 3.2 of the Handbook. The certificate is valid for one certification period, which is defined as three years. Certified producers and certified traders will receive new certificates at the beginning of each certification period. Where there are violations or non-conformity, the National Licenser or EPC may suspend or terminate the license contract. Once the license and certificate are revoked, the ID number of that certified company will be blacklisted and will not be re-assigned. The licensee may re-apply for certification, but only after one year. In the event the application is approved, a new ID number would be assigned.

Sections 4 and 5 of the Handbook deal with the certification seal and traceability. Each certified producer and trader has a unique certification seal for each pellet quality class it produces or sells. The ENplus ID is an essential component of the seal. This enables a tracking system to be in place which serves as a mode of quality assurance. Through this, any breakdown in the supply chain can be identified and traced from the end consumer back to the producer. Each bag of pellets would have to be appropriately labelled and indicate the relevant certification seal and ENplus ID.

5. Certification of Pellet Manufacturers

Part II of the Handbook deals specifically with the certification of pellet producers. Section 9.2 requires the applicant to enter into an inspection contract with an inspection body. As stipulated under section 9.3, auditors from the inspection body will take samples from production in order to examine the origin of raw materials and the use of additives. The auditors will also inspect the internal sampling and quality testing at the premises and determine the suitable test procedure for self-monitoring. These reports will be submitted to the certification body which in turn submits

[15] Defined as associations from various countries or geographic areas that represent the interests of the pellet sectors which have entered into licensing agreements with AEBIOM.

a conformity report to the EPC or National Licenser. Where there are major non-conformities, the certification body will require the defects to be corrected and order a new audit.[16]

a. Audits

Upon being certified, Section 10 stipulates that the facility will be inspected annually and this may be carried out unannounced.

b. Quality Management

Section 11.1 addresses quality management and requires production facilities to, *inter alia*:

i. ensure suitable technical equipment for production, loading, and packaging of wood pellets;
ii. individually inspect the adequacy of raw materials;
iii. avoid contamination of raw materials;
iv. inspect internal and external vehicles of contaminants;
v. ensure the separation of fine materials;
vi. handle pellets in dry areas and protect them from moisture;
vii. avoid the blending of wood pellets belonging to different quality classes; and
viii. conduct in-house quality inspections.

As provided under section 11.2, an experienced employee must be appointed as quality manager who is required to maintain correct internal documentation and is responsible for self-inspections. The documentation must encompass the following:

i. details of raw materials and additives—including quantity and name of supplier;
ii. details of outgoing goods—including details of vehicles used;
iii. details of production of pellets—including period, quality class, and quantity;
iv. records of malfunctions in the production process;
v. results of self-inspection; and
vi. records of customer complaints.

These records should be regularly presented to management. As for self-inspections, section 11.4 requires the producer to test the quality of the pellets in terms of bulk density, moisture, mechanical durability, length, and fines at least once a shift accordingly to the formula provided therein.

c. Sustainability

Sustainability requirements are provided for under section 11.5. Certified producers are expected to commit to ensuring that their sourcing for raw material as well as production operation complies with "generally accepted sustainability principles." They are required to sign a statement of commitment to that effect which allows the National Licenser or EPC to audit them where there are concerns of violation. This "Statement of Commitment to Sustainable Pellet Production" can be found in Annex 7 of the Handbook. The wood pellet producer would have to affirm that it is committed to ensuring that its sourcing practices and production operations are in accordance with certain principles. Further, as further provided under section

[16] Major non-conformities are those that could influence the quality of the product such as inappropriate raw material or defective production and storage facilities.

11.5, producers are required to document the origin of their raw materials and disclose the total amount of raw material originating from forests, plantations and other sources of virgin wood and the total amount of residues used for pellet production. Section 11.6 also requires producers to state their carbon footprint, i.e. the amount of carbon dioxide emitted per metric ton of pellets produced. The EPC or National Licenser will publish the aggregated results of all pellet producers. Annex I will discuss this sustainability requirement under the ENplus scheme as well as current trends under independent certification schemes.

6. Certification of Pellet Traders

Certification of pellet traders is governed by Part III of the Handbook. Section 12 lays down the requirement that traders who deal in bulk require certification. This includes companies that buy loose pellets and bag them as well as certified producers who deliver loose pellets to consumers. External service providers[17] need not be certified. Traders are permitted to sub-license their certification. The non-certified trader must not have technical equipment such as stores and delivery vehicles. In essence, the physical handling of the pellets must be performed by the certified trader. The purpose of having non-certified traders is merely to increase the number of pellet selling points.

a. Audits

Inspections are to be carried out by an inspection body as provided for under section 13, within the first year of certification, and thereafter at least once in each certification period. Such inspections may be carried out unannounced. The auditor inspects the storage facilities, operating equipment and delivery vehicles, as well as check delivery documents and the internal documentations. Just like in the case of pellet producers, an inspection report will be sent to the certification body, which in turn would submit a conformity report to the National Licenser or EPC. In cases of non-conformities, a reasonable deadline (not more than 10 weeks) may be set to correct the defects, failing which the certificate can be revoked. In cases of major non-conformities, a new surveillance inspection can be ordered after the defects have been corrected.

b. Quality Management

Section 14 deals with quality management, and section 14.1 mandates that the following requirements be fulfilled during storage and delivery to end customers:

i. ensure adequate technical equipment for storage, handling, and delivery of pellets;
ii. continuous checking of manipulation areas, silos, and conveyor equipment;
iii. avoid exposure to moisture;
iv. different pellet qualities have to be stored separately during transportation;
v. temperature of loaded pellets must not exceed 40°C;
vi. the transport vehicle must have certain equipment;
vii. coating agents must be limited to 0.2% (by weight) of the pellets; and
viii. a checklist stating all details for the quality of delivery is completed when delivery is made to the end customer.

[17] This includes freight forwarders and storage companies acting on behalf of a certified trader. However, the certified trader would have to register the delivery vehicles and storage facilities with the certification body.

Similarly, section 14.2 requires a quality manager to be appointed to maintain internal documentation in accordance with section 14.3 and to carry out self-inspection in accordance with section 14.4.

c. Sustainability

In contrast with pellet manufacturers, there are no sustainability requirements imposed on pellet traders.

C. CANplus

The CANplus system adopted by WPAC "*employs the identical set of parameters as the ENplus certification*" and expressly stipulates that organizations with ENplus certification are eligible for CANplus trademark licenses.[18] As such, the technical standards for wood pellets under CANplus are the same as the standards under ENplus.

As for the process of certification, details of the scheme can be found in the CANplus Handbook for the Certification of Wood Pellets for Heating Purposes (Version 2).[19] In essence, WPAC is the National Licenser of ENplus for Canada.[20] Thus, organizations that have obtained ENplus certification are eligible for CANplus trademark licenses. To obtain the CANplus license, Section 3.2 of the CANplus Handbook stipulates that an applicant would first have to obtain ENplus certification, and then fill out a CANplus application form. WPAC reviews the application and sends it to its certification body, Control Union, for certification.[21] With respect to the first surveillance audit, the CANplus audit will be conducted simultaneously with the ENplus audit. As required under section 4.2, the CANplus seal must be accompanied by the ENplus seal. Section 5.1 stipulates that organizations that are paying ENplus license fees are exempted from CANplus licensing fees. CANplus certification is dependent on ENplus certification, and section 6 provides that CANplus certification would terminate when the ENplus certification is resigned, revoked, or suspended. WPAC also reserves the right to revoke CANplus certifications if the conduct of a particular organization is deemed inappropriate or unethical.

D. DINplus and DIN Geprüft

1. Background Information

DINplus and DIN Geprüft are administered by DIN CERTCO and are mainly used within Germany. The pellet specifications under DINplus and DIN Geprüft are virtually identical to that of ENplus. It should be pointed out that there is one major distinction between ENplus and DINplus—while ENplus provides certification for manufacturers as well as traders of pellets, the DINplus certification scheme is only applicable to producers of wood pellets. Suppliers and

[18] Wood Pellet Association of Canada, *CANplus Handbook for the Certification of Wood Pellets for Heating Purposes*, Version 2.0 (September 2013), *available at* www.controlunion.ca/fileupload/CA/Certifications/ENplusCANplus/CANplus_handbook_v2-0.pdf.

[19] Wood Pellet Association of Canada, *CANplus Handbook for the Certification of Wood Pellets for Heating Purposes*, *Version 2.0* (Sept. 2013), *available at* www.controlunion.ca/fileupload/CA/Certifications/ENplusCANplus/CANplus_handbook_v2-0.pdf.

[20] Control Union Canada, *ENplus/CANplus*, http://controlunion.ca/canplus, last visited May 7, 2015.

[21] *Id*. Control Union is an approved certification body, inspection body and testing body under ENplus and CANplus.

transportation companies may apply for a separate certification mark, known as the "DIN-Geprüft qualified enterprises of pellet logistics" certification mark, from DIN CERTCO as proof of quality.

2. DINplus

DINplus standards for residential pellets are virtually identical to ENplus-A1 standards.[22] DIN CERTCO also maintains a separate scheme for industrial pellets—the DIN Geprüft standards for industrial pellets (DIN Geprüft).[23] The DIN Geprüft standards are identical to EN-B standards. The specifications for both the DINplus and DIN Geprüft standards are included in the table at the end of this paper.

a. Technical Specifications—What is Required and What is Prohibited

Under the DINplus scheme, wood pellets may only be produced from untreated wood. Certified pellets may be made only from stem wood and chemically untreated wood residue, and wood pellet manufacturers are required to keep records on the source of their wood.[24] Foreign substances are not permitted except for negligible amounts of by-products used in sawmills during the production of timber.[25]

Under the DIN Geprüft scheme, industrial wood pellets may be produced from forest, plantation and other virgin wood, by-products and residues from wood processing industry, and used wood.[26] Foreign substances are permitted provided they do not contain heavy metals or halogenated organic compounds as a result of treatment with preservatives or due to coatings.[27]

b. Overview of Certification Process

The DINplus certification scheme applies only to manufacturers of wood pellets. It does not cover suppliers of wood pellets or transportation companies, which may apply for a separate proof of quality known as the "DIN-Geprüft qualified enterprises of pellet logistics" certification mark under a separate scheme, which is also administered by DIN CERTCO.

As stipulated under section 5, the pre-requisite for certification is a prior appraisal by a DIN CERTCO inspector followed by the testing of wood pellets as well as an on-site factory inspection. In conducting a conformity examination, DIN CERTCO will rely on the application form, the report from the testing laboratories, and the report of the factory inspection. If there are any deviations, the applicant will receive notice from DIN CERTCO. Otherwise, in the event

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[22] DIN CERTCO, *DINplus Wood pellets for use in small furnaces certification scheme* (2014), *available at* www.dincertco.de/media/dincertco/dokumente_1/certification_schemes/Holzpellets_wood_pellets_certification_scheme.pdf. In section 3.3, DINplus allows for some minor leeway in terms of fines and ash melting behavior. Note: There is only one grade under the DINplus system.

[23] DIN CERTCO, *DIN Geprüft Industry pellets certification scheme* (2010), *available at* www.dincertco.de/media/dincertco/dokumente_1/certification_schemes/Industriepellets_industry_pellets_certification_scheme.pdf.

[24] *DINplus certification scheme*, *supra* note 22, at § 3.1.

[25] *Id.* § 3.2.

[26] DIN Geprüft certification scheme, *supra* note 23, at § 3.1.

[27] *Id.* § 3.2.

that the conformity assessment is positive, DIN CERTCO will issue a certificate to the applicant with a registration number and the right to use the "DINplus" mark. The certificate is valid for five years and may be renewed by a timely application for renewal.

As provided under section 5.8, if the certificate holder makes any alteration to the certified product, DIN CERTCO must be notified without delay and DIN CERTCO may require an examination to be conducted. If a substantial alteration is made, the certificate shall expire. Nevertheless, a new application may be submitted. Where a certified product in the market is found to be defective, section 5.9 allows DIN CERTCO to require the certificate holder to rectify the defects. Where the defects have an effect on the safety or functionality of the product (i.e. a serious defect), the manufacturer shall not mark the product using the DINplus mark until such defects are rectified. Where the defects are minor, the manufacturer will be required to remedy the defects within three months, failing which the use of the mark will no longer be permitted.

c. Audits

Audits are to be conducted annually, and where possible, unannounced. The manufacturer must appoint a specialist manager to be present during the inspection and to provide all documentary evidence as required. Samples will be taken for testing across all certified products. The inspection report must contain information on:

i. the origin, type, composition, and quality of raw materials used;
ii. storage of raw materials and end products;
iii. the details on the production process;
iv. the internal quality assurance system in place;
v. the supplying of pellets;
vi. summary of deviations (if any) and corrective actions required; and
vii. the inspector's appraisal.

The results of the factory inspection and laboratory testing will be summarized and the manufacturer will be informed of any defects which would require attention. The same procedure as in section 5.9 will apply where there are defects.

d. Quality Management

Section 6.2 requires the manufacturer to establish an in-house factory production control system, in which the production process is continuously monitored, as well as a quality management system. This requires the manufacturer to conduct regular visual inspections of incoming raw materials (section 6.2.1.1). A declaration from the wood supplier must be obtained by the manufacturer stating the quality of the wood in terms of its naturalness (alternatively, analyses for chlorine, ash, and nitrogen values must be performed). Fines must be screened out before loading or packaging (section 6.2.1.2).

Pursuant to section 6.2.1.3, monitoring tests must be carried out by qualified personnel at least once every eight hours to determine:

i. water content;
ii. mechanical durability;
iii. bulk density;
iv. length; and
v. the type and quantity of additives used.

If the product fails a test, the manufacturer must take immediate corrective measures to remedy the shortcomings and faulty products must be scrapped. The results of self-monitoring must be documented. Section 6.2.1.4 requires a reference sample of 1.5 kg to be taken daily and stored for at least nine months. Further, the manufacturer must have written procedures for monitoring incoming and outgoing products, monitoring testing equipment, implementation of self-monitoring tests, protocols to handle abnormalities, dealing with complaints, and employee training. The execution of those responsibilities must be properly documented and these records must be provided to DIN CERTCO on request.

3. The DIN-Geprüfter Fachbetrieb Certification Scheme

As discussed above, the DINplus certification scheme applies only to the manufacturers of wood pellets. The DIN-Geprüfter Fachbetrieb Certification Scheme is the relevant certification scheme for the remainder of the supply chain. This certification program distinguishes between forwarders and dealers. Forwarders are transport companies that only transport wood pellets, whereas dealers are transport companies that also maintain warehouses for interim storage. Details on the schem can be found in the "Woodpellets – Quality assurance in the field of logistics of transport and storage" Handbook,[28] also issued by DIN CERTCO.

a. Overview of the Certification Process

Section 3.1.1 of the Handbook draws the link between the DIN-Geprüfter Fachbetrieb Certification Scheme and the DINplus Certification scheme. It requires the forwarder or dealer to ensure that only certified wood pellets with the quality mark DINplus are delivered. Section 3.1.2 mandates that DINplus-certified pellets be stored and transported separately from non-certified pellets or other materials.

Section 5 deals with the certification process itself. The applicant is required to submit a written application with documents such as technical data on delivery vehicles, quality manuals of the work place, and other related documents. Once these documents are verified by DIN CERTCO, the applicant will be admitted to the certification procedure. DIN CERTCO will then conduct the conformity assessment which includes authorizing a random inspection pursuant to section 4 and considering the test report submitted in accordance thereof. Upon successfully completing all of the above, the applicant will be issued a certificate with the right to use the "DIN-Geprüfter Fachbetrieb – Pelletlogistik" Certification Mark. Section 5.6 provides that the certificate is valid for five years and may be renewed by further application.

b. Audits

As stipulated under section 7, dealers of pellets are subjected to audits at least once a year while transport vehicles are audited every three years. On the other hand, exclusive forwarders and their transport vehicles are subject to inspection every three years. As a general rule, the inspections are to be announced beforehand.

[28] DIN CERTCO, *DIN-Geprüfter Fachbetrieb – Pelletlogistik Certification Scheme for Woodpellets – Quality Assurance in the field of logistics and storage*, January 2012 edition. Electronic copy obtained on March 6th, 2015 through online email request to DIN CERTCO.

c. Quality Management

The requirements for interim storage are described in section 3.2: all handling surfaces must have roofs (section 3.2.1), the storage halls must be closed on all sides, pellets must be stored dry in closed silos and kept free from moisture or contamination such as soil or sand (section 3.2.2), and fine particles must be removed prior to delivery and may not exceed 1% (section 3.2.3).

Section 3.3 stipulates the requirements for transport vehicles. The transport vehicles must be designed to ensure that wood pellets are protected from moisture throughout the entire transportation process including when loading and unloading (section 3.3.1). According to section 3.3.2, where a silo-lorry is used, there must be a suction system (with a greater capacity than that of the vehicle compressor) in place to suction out the air blown in from the storage room.

Section 3.4 lays down certain qualification requirements that the delivery personnel are required to possess. The dealer or forwarder must ensure that there are work instructions in place that are used to train delivery staff (section 3.4.1). The delivery staff must also fill out a check list for every delivery which includes details on heating, storage details and other related information (section 3.4.2).

Section 4 lays down the testing component of the certification process. It involves an on-site inspection to ensure that all paper documentation has the word "DINplus" on it to show that that the company is transporting and storing only DINplus-certified pellets. Samples will be taken from pellets in the storage facilities to determine details such as abrasion, water content and density. Transport vehicles will be inspected to ensure that pellets are protected from moisture, to test the mechanical stress caused to wood pellets by the vehicle's conveying unit, and to ensure the capacity of the suction system and the vehicle compressor in the case of the silo-lorry. The inspector is also required to ensure that the work instructions are issued and all related personnel have been trained accordingly. The inspector will then prepare and submit a test report to DIN CERTCO. DIN CERTCO may require a further special test if it deems necessary.

Section 6 stipulates the requirements for the self-monitoring process by the company. The dealer or forwarder is required to conduct on-going quality assurance checks. This includes visual inspection of all pellet deliveries received from a DINplus-certified warehouse and documentation of cleanliness, purity, and fine particle percentage of the pellets, alongside continuous inspection of storage facilities and vehicles to ensure the suitability of conditions. Documentation of all self-monitoring measures must be presented during third party audits.

E. BANZ Guidelines

1. Background Information

The BANZ Guidelines are a voluntary industry standard in New Zealand, although it is anticipated that they might be the basis for a future mandatory standard.[29] The BANZ Guidelines were developed jointly by the Bioenergy Association of New Zealand and the Energy Efficiency and Conservation Authority (EECA) of New Zealand.

[29] Bioenergy Association of New Zealand, *Wood Fuel Classification Guidelines, Version 5*, at 1 (2010), available at www.eeca.govt.nz/sites/all/files/banz-wood-fuel-classification-guidelines-july-2010.pdf. Because it is a voluntary standard that is not enforced, there is no enforcement and implementation scheme to discuss.

2. Grades

The Guidelines stipulate that the wood pellets are "*to be produced from high quality wood residues*" and provides three different categories of pellet standards: Category A (premium pellets), which is generally for domestic/residential heaters; Category B (large premium pellets), which is for use in selected boilers, usually small to medium sized commercial boilers; and Category C (industrial grade pellets), which is for use in large industrial boilers.[30]

3. Technical Specification—What is Required and What is Prohibited

Category A pellets can be manufactured only from virgin wood fibre, untreated and free from contamination. They must have extremely low levels of ash levels, and the fuel and resulting ash should be able to be certified as organic.[31] Category B pellets, although also of high quality, are suitable for larger scale applications mostly due to differences in terms of size from Category A pellets. Both Category A and B pellets can be used in smoke control areas.[32] Category C pellets, by contrast, are suitable for larger scale applications outside smoke control areas, and do not have the environmental advantages of Category A and B pellets such as low ash content and low emission levels.[33] The detailed specifications for each category are included in the table at the end of this paper.

For all grades, the use of construction or demolition wood (referred to as "waste") is permitted, but only under limited circumstances and after complying with the consent process under the Resource Management Act.[34] The use of treated waste wood is permitted but only in high temperature combustion plants that are specifically designed to handle such wood. Untreated waste wood can be used, but only if the wood has been assessed to ensure the absence of treated timber. Contaminated (i.e. with preservatives, paints, glue or other non wood materials) waste wood may be used only in a high temperature combustion plant that is specifically designed to handle such wood.

Annexes

This document concludes with two annexes Annex I summarizes the approaches taken to assessing wood pellet sustainability by ENplus as well as several independent sustainability schemes. Annex II shows a table summarizing EPA, PFI, ENplus, DIN plus, and BANZ wood pellet standards. As mentioned earlier, CANplus does not have its own standards and thus is not included.

[30] *Id.* at 11.

[31] *Id.*

[32] *Id.* at 12.

[33] *Id.* at 13.

[34] *Id.* at 14.

Annex I: Wood Pellet Sustainability

I. ENPLUS

As discussed earlier, under the ENplus certification scheme (section 11.5), pellet manufacturers are required to sign a "Statement of Commitment to Sustainable Pellet Production" whereby the manufacturer affirms that it is committed to ensure that its sourcing practices and production operations are in accordance with the following principles:[35]

1. The production of woody biomass:

    a. does not significantly take place at the expense of the net carbon balance of carbon reservoirs in vegetation and soil;
    b. does not interfere negatively with the biodiversity within the forest of origin;
    c. maintains or improves soil quality; and
    d. does not exhaust ground and surface water and avoids or significantly limits negative impacts on water resources.

2. The production of pellets:

    a. avoids or significantly limits negative impact on air quality;
    b. does not endanger food, water supply or subsistence means of local communities; and
    c. respects property rights and contributes to local prosperity and to the welfare of the employees and local population

3. Ethical principles related to health and safety, human rights, freedom of association, compulsory labor, child labor, discrimination, environmental responsibility, business integrity and corruption in all its forms are fully respected.

4. Wood sourcing is fully compliant with the European Timber Regulation ("EUTR") and the EU Forest Law Enforcement, Governance and Trade ("FLEGT") regulations.

Producers are further required to document the origin of their raw materials and disclose the total amount of raw material originating from forests, plantations, and other sources of virgin wood and the total amount of residues used for pellet production to the inspection body during the annual audit. Apart from that, producers must state their carbon footprint, i.e. the amount of carbon dioxide emitted per metric ton of pellets produced. Pursuant to section 11.6, this figure must be included in the audit report.

From this, it can be observed that ENplus takes the sustainability requirement very seriously. However, having required pellet producers to sign a statement of declaration affirming a commitment to sustainable sourcing of its wood supply, ENplus stops short of requiring any further verification or certification scheme to regulate the supply chain.

II. INDEPENDENT SUSTAINABILITY SCHEMES FOR WOOD PELLET

In Europe, energy utilities have started to come together to form the Sustainable Biomass Partnership (SBP) in 2013. While there has not been a uniform scheme under the SBP to date,

[35] See Annex VII of the ENplus Handbook.

there are, however, some emerging schemes in Europe that deal with sustainable wood pellet production: (1) the Green Gold Label Certification; (2) the SGS-Laborelec Biomass Verification Procedure; and (3) the Blue Angel Eco-Label for Technically Dried Wood Chips and Wood Pellets.

A. Green Gold Label Certification

The GGL Certification has been operational since 2002 in the Netherlands and covers both wood-based and non-wood based biomass. It covers the production, processing, and transportation stages and allows for the origin of the biomass to be tracked. Details on the GGL scheme can be found on its website.[36] Through the GGL Certification Regulation handbook,[37] a functional certification scheme has been developed by the Board of the Green Gold Label Foundation. As provided under Article 1, producers, processors and traders of biomass material may apply for accreditation to a certification body. Article 2 states that the scheme covers the entire chain of biomass for energy production.

The GGL scheme offers numerous certifications that are pertinent to wood pellet producers and traders, for instance:[38]

1. Option GGSL-1: Chain of Custody and Processing Standards for First Entry Point or trader which process forestry products, and applying for certification for the production of biomass.

2. Option GGSL-3: RED Compliance for First Entry Point or traders that process, convert or trade forestry product, and applying for the production of biomass/biofuels.

3. Option GGSL-5: Forest Management Criteria for producers of products and residues from forestry, and applying for source certification.

4. Option CRM-1: Chain of Custody and Processing Standards (for clean raw materials).

For all of the above options, a participant must only receive raw materials from suppliers certified under forestry certification schemes that are recognized by Green Gold Label. Further, a certified participant is subjected to at least one announced site inspection annually.

B. SGS-Laborelec Biomass Verification Procedure

In 2009, SGS and Laborelec put together a verification procedure for biomass applicable in Belgium.[39] Its purpose is to (1) ascertain the total energy consumption along the pellet supply chain, and (2) ensure the full traceability of the resources that were used for manufacturing pellets. First, the pellet supplier is required to fill in an official declaration ("Pellet Supplier Declaration Form") that the source was obtained from a traceable origin and that inspection of the production site by an independent auditor is authorized. Second, an independent inspection company appointed by SGS Belgium will conduct an on-site audit to verify data about sourcing

[36] Available at: http://www.greengoldcertified.org/site/pagina.php?, last accessed: March 1st, 2015.

[37] Available at http://www.greengoldcertified.org/site/pagina.php?id=49, last accessed: March 1st, 2015.

[38] Article 14 GGL Certification Regulation handbook. For details on each of the various options, see http://www.greengoldcertified.org/site/pagina.php?id=11, last accessed: March 3rd, 2015.

[39] Available at: http://www.laborelec.be/ENG/biomass-verification-procedure/, last accessed: March 3rd, 2015. All related documents can be obtained at this website.

of raw material, the production chain, quality of the product, and transportation details. An audit report will be prepared and sent to SGS Belgium ("Pellet Supplier Audit Report"). Finally, SGS Belgium will peruse the report and calculate the total greenhouse gas emissions throughout the supply chain ('Energy and Carbon Balance Form').

C. Blue Angel Eco-Label for Technically Dried Wood Chips and Wood Pellets

The Blue Angel Eco-Label, a German certification awarded for environmental friendly products since 1978, is the world's oldest ecolabel. In 2011, RAL gGmbH introduced the Blue Angel Eco-Label for Technically Dried Wood Chips and Wood Pellets[40] for domestic use in Germany. As provided under section 3.1.1, only freshly cut green wood and chemically untreated wood residues may be used as raw materials for wood pellet production. This includes: whole trees without roots, stem wood, logging residues, and chemically untreated wood residues. The origin of the raw material must be recorded as well as all transportation distances and expenses. As provided under sections 3.1.3 and 3.1.4, wood from short-rotation forestry (felling cycles of less than 20 years) and continuously forested areas must comply with various institutional directives as stipulated therein.

Section 3.2.1 requires producers to ensure that heat used to dry wood pellets must come from renewable sources. Evidence of efficient use of drying energy shall be presented and all related details pertaining heating must be recorded. Section 3.3.1 requires wood pellets to meet the specification of the DINplus or ENplus standards as well as comply with third party inspections under either of those certification schemes.

Pellet dealers may also apply for a separate Blue Angel Eco-label certification provided the product has already been certified (section 3.5). The dealer shall be subjected to a simplified verification procedure and is required to document all transportation expenses that are incurred in the storage and delivery activities.

III. INDEPENDENT CHAIN OF CUSTODY SCHEMES

Apart from the independent schemes that are specific to wood pellets, there are numerous other independent schemes on sustainable forest practices that are relevant for the regulation of the supply chain of forest products; for instance: (1) the Forest Stewardship Council (FSC) Chain of Custody Certification;[41] (2) the Sustainable Forestry Initiative (SFI) Chain of Custody Certification;[42] and the Programme for the Endorsement of Forest Certification (PEFC) Chain of Custody Certification.[43] These schemes essentially track certified material from the forest to the final product to ensure it originates from certified forests. In order for the end product to qualify for certification, all entities along the supply chain must be in compliance with the requirements set out by the respective schemes. Under each of these schemes, certificate holders are subjected to annual audits.

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[40] Available at: https://www.blauer-engel.de/en/products/energy-heating/technically-dried-wood-chips-wood-pellets/wood-pellets, last accessed: March 3rd, 2015.

[41] Available at: https://us.fsc.org/download.fsc-standard-for-chain-of-custody-certification-v2-1.a-187.pdf.

[42] Available at: www.sfiprogram.org/files/pdf/section3sfirequirements2010-2014pdf/.

[43] Available at: http://pefc.org/standards/technical-documentation/pefc-international-standards-2010/1193-chain-of-custody-of-forest-based-products-requirements-pefc-st-2002-2013.

Annex II

Table of Comparison between Wood Pellet Standards determined by EPA, PFI, ENplus, DINplus and the BANZ Guidelines.

	EPA minimum standards	PFI			ENplus			DIN CERTCO		BANZ Guidelines		
		PFI Premium	PFI Standard	PFI Utility	A1	A2	B	DINplus	DIN Geprüft	A	B	C
Diameter (mm) *(inches)*	5.84 - 7.25 *(0.23-0.285 inches)*	5.84 - 7.25 *(0.23-0.285 inches)*			6 or 8 *(0.236 or 0.315 inches)*			D06, 6 ± 1.0 D08, 8 ± 1.0		6	< 10	
Length (mm) *(inches)*	≤ 38 *(≤ 1.5 inches)*	≤ 38[i] *(≤ 1.5 inches)*			3.15 ≤ L ≤ 40[ii] *(0.124 ≤L≤ 1.575 inches)*			3.15 ≤ L ≤ 40[iii]		< 6		
Moisture Content (w-%)	n/a	≤ 8	≤ 10		≤ 10			≤ 10		< 10[iv]		< 15
Ash content (w-%)	≤ 2	≤ 1	≤ 2	≤ 6	≤ 0.7	≤ 1.5	≤ 3.0	≤ 0.7	≤ 3	< 1		< 5
Durability (w-%)	n/a	≥ 96.5	≥ 95		≥ 97.5		≥ 96.5	≥ 97.5	≥ 96.5	97.7		90
Fines (w-%)	≤ 1	≤ 0.5	≤ 1		≤ 1			≤ 0.5[v] or ≤ 1[vi]	≤ 1	< 1	< 4	< 10
Net calorific value (MJ/kg)	n/a	n/a			16.5 ≤ Q ≤ 19	16.3 ≤ Q ≤ 19	16 ≤ Q ≤ 19	≥ 16.5	16 ≤ Q ≤ 19	> 17		> 10
Bulk density (kg/m3) *(lbs/ft^3)*	≥ 609 *(≥ 38 lbs/ft^3)*	640 - 737 *(40 - 46 lb/ft^3)*	609 - 737 *(38 - 46 lb/ft^3)*		≥ 600 *(≥ 37.457 lbs/ft^3)*			≥ 600		> 650	> 600	> 550
Additives (w-%)	n/a	≤ 2[vii]			≤ 2[viii]			≤ 2[ix]		< 1		< 10
Chlorine content (w-% dry)	≤ 0.03	≤ 0.03			≤ 0.02		≤ 0.03	< 0.02	≤ 0.03	< 0.002	< 0.005	Must state
Nitrogen content (w-% dry)	n/a	n/a			≤ 0.3	≤ 0.5	≤ 1	≤ 0.3	≤ 1	n/a		
Sulphur content (w-% dry)	n/a	n/a			≤ 0.03		≤ 0.04	≤ 0.03	≤ 0.04	< 0.05	< 0.1	Must state

Total trace metal (mg/kg) Arsenic (mg/kg dry) Cadmium (mg/kg dry) Chromium (mg/kg dry) Copper (mg/kg dry) Lead (mg/kg dry) Mercury (mg/kg dry) Nickel (mg/kg dry) Zinc (mg/kg dry)	< 100mg/kg	n/a	Individually regulated ≤ 1 ≤ 0.5 ≤ 10 ≤ 10 ≤ 10 ≤ 0.11 ≤ 10 ≤ 100		Individually regulated ≤ 1 ≤ 0.5 ≤ 10 ≤ 10 ≤ 10 ≤ 0.1 ≤ 10 ≤ 100	n/a
Ash melting behavior (deformation temperature) (°C)	n/a	Value must be stated[x]	≥ 1200[xi]	≥ 1100[xii]	Value must be stated[xiii]	n/a

[i] A maximum of 1 w-% of the pellets may be longer than stated maximum.
[ii] A maximum of 1 w-% of the pellets may be longer than stated maximum.
[iii] A maximum of 1 w-% of the pellets may be longer than stated maximum.
[iv] Limit of <8% for test fuels when testing appliances.
[v] Small bags (up to 20kg)
[vi] Large sacks & bulk ware
[vii] Type of additives must be defined, PFI Residential/Commercial Densified Fuel QA/QC Handbook, section 8.
[viii] Additives are allowed to a maximum of 2% of the total mass of the pellets. The amount of additives must be limited to 1.8 w-%, the amount of post-production additives must be limited to 0.2 w-% of the pellets. The type and quantity of all additives has to be documented.
[ix] Type of additives must be defined.
[x] PFI Residential/Commercial Densified Fuel QA/QC Handbook, section 8.
[xi] Sample preparation at 815°C.
[xii] Sample preparation at 815°C.
[xiii] Preashing with 815°C is allowed, but must be stated.

Sources:

Environmental Protection Agency, *EPA Final Rule on Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces*, 40 CFR 60.

Pellet Fuels Institute, *PFI Fuels Institute Standard Specification for Residential/Commercial Densified Fuel* (2011), *available at* http://www.pelletheat.org/assets/docs/pfi-standard-specification-november-2011.pdf.

Pellet Fuels Institute, *PFI Residential/Commercial Densified Fuel QA/QC Handbook, available at* http://www.pelletheat.org/assets/docs/qa-qc-handbook-november-2011.pdf.

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