

FINAL TECHNICAL REPORT

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ACRONYM : BioNorm

**TITLE : Pre-Normative Work on Sampling and Testing of
 Solid Biofuels for the Development of Quality
 Assurance Systems**

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- 2 GLR Green Land Reclamation Ltd., United Kingdom
- 3 CTI Comitato Termotecnico Italiano, Energia e ambiente, Italy
- 4 TFZ Technology and Support Centre of Renewable Raw Materials, Germany
- 5 INETI Departamento de Engenharia Energética e Controlo Ambiental / Instituto Nacional de Engenharia e Tecnologia Industrial, Portugal
- 6 SFN Signalsfromnoise.com Ltd, United Kingdom
- 7 TNO Institute of Environmental Sciences, Energy Research and Process Innovation, The Netherlands
- 8 SLU Swedish University of Agricultural Sciences - Department of Bioenergy, Sweden
- 9 BLT Federal Institute for Agricultural Engineering, Austria
- 10 KCL Oy Keskuslaboratorio, Finland
- 11 USTUTT Institute of Process Engineering and Power Plant Technology, Germany
- 12 OFI Austrian Research Institute for Chemistry and Technology, Austria
- 13 TPS Termiska Processer AB, Sweden
- 14 TUV Vienna University of Technology - Institute of Chemical Engineering, Austria
- 15 NTUA National Technical University of Athens - Department of Chemical Engineering, Greece

16	FORCE	FORCE Technology (former dk-Teknik Energy & Environment), Denmark
17	UOULU	University of Oulu - Department of Chemistry, Finland
18	CIEMAT	Centro de investigaciones energéticas, medioambientales y tecnológicas, Spain
19	ECN	Netherlands Energy Research Foundation, The Netherlands
20	CRA	Centre de Recherches Agronomiques de Gembloux, Belgium
21	DFLRI	Danish Centre for Forest, Landscape and Planning, Denmark
22	HFA	Holzforschung Austria, Austria
23	FCA	Forestry Contracting Association Ltd., United Kingdom
24	FAT	Agroscope FAT Taenikon Swiss Federal Research Station for Agricultural Economics and Engineering, Switzerland
25	AFOCEL	Association Foret Cellulose, France
26	TW	Tech-wise A/S (Elsam), Denmark
27	SKAB	Skelleftea Kraft AB, Sweden
28	VT-TUG	Graz University of Technology, Institute for Resource Efficient and Sustainable Systems, Austria
29	CPERI	Centre for Research and Technology Hellas - Process Engineering Research Institute (CPERI), Greece
30	VTT	Technical Research Centre of Finland, Espoo, Finland
31	SP	Swedish National Testing and Research Institute, Sweden
32	IEC	Technical University Bergakademie Freiberg - Institute for Energy Process Engineering and Chemical Engineering, Germany
33	IFE-A	IFE-Analytik GmbH, Germany
34	CLGE	Central Laboratory of General Ecology – Bulg. Acad. of Sci., Bulgaria
35	KONEKO	KONEKO Marketing Ltd., Czech Republic
36	IPE LAS	Institute of Physical Energetics - Latvian Academy of Sciences, Latvia
37	LEI	Lithuanian Energy Institute, Lithuania
38	BREC	EC Baltic Renewable Energy Centre, Poland
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Executive summary

Due to its advantages (like wide availability, well-known with regard to supply and use and contribution to green house gas mitigation) biomass represents the most important source to address European policies increasing the share of renewable energy sources for a more sustainable energy system. For an improved integration of solid biofuels into the energy system a dynamic European market has to be created. Thus, accomplishable biofuel properties as well as procedures to test and control these defined parameters are required. Therefore, besides the elaboration of an overall Quality Assurance system for solid biofuels based among other on sampling and testing methods, the pre-normative research project (BioNorm) was aimed to directly contribute to the ongoing development of European standards for solid biofuels within CEN TC 335 “Solid biofuels”. Within this project the emphasis was laid on the identification and evaluation of the best appropriate sample-, test- and reference methods for the determination of specific fuel properties. Based on the experiences made respective best practice guidelines were compiled. These guidelines and research findings were incorporated for drafting Technical Specifications within the standardisation process.

In each of the different work packages and tasks respectively various kinds of solid biofuels covering a wide scope of fuels were analysed and investigated by carrying out selected methods. The applied methods and principles were initially identified to be basically suitable for a reasonable determination of (i) the number of increments and tests as well as specific increment sizes in terms of sampling and sample reduction, (ii) the physical/mechanical fuel properties (i.e. moisture content and bulk density, ash melting behaviour, particle size distribution, durability and particle density) and (iii) the chemical fuel characteristics (i.e. sulphur, nitrogen and chlorine as well as major and minor elements). The research has two emphasises. It was focused on the investigation of existing methods and equipment (e.g. applied for solid fossil fuels) with regard to their accuracy for solid biofuels and thus their applicability followed by appropriate adaptation and improvements of these methods and laboratory equipment. In addition, it was also focused on the development of new methods. Referring to this, common statistical parameters such as accuracy, reproducibility and repeatability were used for the assessment of the different sampling and testing methods. Besides technical, also work-efficiency, economical and environmental aspects were considered.

Supported by these research results, new methods for the development and implementation of Quality Assurance systems for the entire biofuel supply chain were evaluated based on an initial review of existing systems as well as extensive field trials at several companies.

The outcome of the pre-normative work of the BioNorm project includes among methods for sampling and sample reduction, improved and new developed methods and procedures for the determination of physical-mechanical and chemical biofuel properties as well as the development and implementation of a company specific Quality Assurance system. Coupled with this, basic recommendations are with regard to apply both the proposal of a standard/TS and the guideline in practice.

In terms of the country conditions in the NMS/NAS recent trends have shown a continuous increasing international market of solid biofuels that also stimulates the domestic production of refined solid biofuels within these countries and thus increase the acceptance of renewable energy sources. Nowadays, these countries already use biomass (predominantly for domestic heat provision) and have very promising potentials concerning biomass and bioenergy utilisation. However, currently limited experience in utilisation of refined solid biofuels and missing R&D contributes to a lack of solid biofuels standards and Quality Assurance guidelines. In all of the NMS/NAS there are no specific biofuel standards and Quality Assurance implemented yet. Companies that produce refined solid biofuels for export currently apply national standards of the import countries. Referring to this, all NAS/NMS-partners clearly stated that common standards are urgently required for increasing the solid biofuel market. Hence, CEN standards currently being developed need to be quickly adopted.

Among the extensive and substantial outcomes during the pre-normative research and the progress of standardisation it has been acknowledged that there is still the demand on research in all purviews such as of fuel classification and Quality Assurance or sampling and testing methods and procedures. Moreover, further cooperation is recommended within the European countries, that already used biomass efficiently and their legislation and biofuels standards are harmonious developed.

Finally, the outcomes reveal that BioNorm has crucially contributed to clarify important issues and aspects associated with the ongoing European standardisation process for solid biofuels. This is in particular true referring to biofuel terminology and specification, appropriate procedure and methods for sampling and testing of fuel properties as well as the importance of company specific Quality Management systems. Furthermore, a basis for research exchange with the NMS/NAS has been established that will be further delved and extended in the future. However, BioNorm has also point out the urgent need on further investigations and method development. Therefore, continuing R&D support of the ongoing standardisation activities will be of high importance to close the gaps and to ensure that the European market for solid biofuels and thus the biomass industry will continue to grow rapidly in the future helped by acceptable standards.