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Ministry of Infrastructure and Water Management, Ministry of Climate and Green Growth
P2X fuels subsidy scheme | Stakeholder Input

This comment specifically intends to recommend the continued use of the carbon-14 testing method to determine the share of biogenic carbon content in alternative and sustainable fuels incorporated within the Scheme. Biogenic content measurements following ASTM D6866 Method B currently provide critical value to programs worldwide aiming at reducing carbon emissions and helping the development of cleaner renewable energy.

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Recommendations for the P2X Fuels Subsidy scheme

In response to question 13 of the consultation document "Are there any other matters you would like to mention that have not yet been addressed??", we recommend that incentives aimed at promoting the production and use of renewable energy resources for the transport sector, through the use of renewable biofuels, be linked to direct Carbon-14 testing using the ASTM D6866 Method B or equivalent standards for any biofuel seeking recognition of renewable content.

As the program's goal is to comply with ReFuelEU, which requires aviation fuel suppliers to ensure that from 2025, a minimum of 2% of the supplied fuels are sustainable, and 70% by 2050, it is essential that this sustainable criteria is determined and proved using direct testing. This is important as other methods, such as calculation-based methodologies, are inaccurate and routinely overestimate the biogenic content of biofuels. We encourage linking any incentives to strict testing requirements using the Carbon-14 methodology, as this will also incentivise the use of renewable feedstocks and actively help reduce greenhouse emissions as producers will have to report their actual fuels' renewable content accurately.

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Other similar programs have highlighted the risks of laxer requirements. This threat was particularly highlighted by 2023's recent mass balance fraud challenge faced by the ISCC regarding fraudulent biodiesel submissions from East Asia which "caused a dramatic fall in biodiesel prices in European markets."[1]. As a result, the EU quickly updated the program's reporting requirements to require routine direct biogenic testing to verify any calculations by direct testing at least quarterly using Carbon-14 analysis to verify that those calculations align with reality.

Another example is the recent audit of the US Treasury into potential fraud in the biofuels Tax Credit program which improperly granted $30,3 million in credit in 2022[2]. Hence, while incentives are important for the development of the industry, strict enforcement and verification methods ought to be put in place to limit fraud cases.

Those examples highlight that calculation-based methodologies, such as the mass-balance methodology, cannot provide the necessary consistency or transparency, specifically because they cannot offer direct measurement. Calculation-based approaches allow producers to assume that all of their biomass inputs end up in their facilities' outputs, despite being well understood in the industry that the input of renewable feedstocks is not the same as the output because performance varies and renewable feedstocks don't produce the same quantity of material as their fossil counterparts.[3] By basing their calculations solely on production inputs rather than outputs the method systematically over-reports the biobased share of products.

The lack of transparency and accuracy between the calculation-based methodologies pushed the EU to impose stricter Verification and Reporting requirements for the EU ETS to incorporate measures aimed to "*avoid systematic underestimation of the total emissions in the mass balance system*"[4]. Such requirements include notably the obligation on verifiers to verify the consistency between reported data and mass balance documentation and to verify the information given in reporting plans using a calculation methodology[5]. Since the goal of incentivizing biofuels is to achieve emissions reductions compared to fossil fuels, biogenic content must be accurately measured to ensure the program only incentivizes real decarbonization.[6]

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[1] 2023. "ISCC Press Release July 27, 2023." *International Sustainability & Carbon Certification*

[2] 2024, US Treasury, "Additional Actions Need to Be Taken to Identify and Address Noncompliant Biofuel Tax Credit Claims", 2024-300-021.

[3] 2006. "Determining the modern carbon content of biobased products using radiocarbon analysis." *Bioresource Technology*, 97(16), 2084-2090.

[4] 2024, European Commission "Emissions trading system (ETS) Monitoring and Reporting Regulation amendment in response to the ETS revision". Available here: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14217-Emissions-trading-system-ETS-Monitoring-and-Reporting-Regulation-amendment-in-response-to-the-ETS-revision_en

[5] 2024, European Commission "EU emissions trading system – update of the Verification and Accreditation Regulation". Available here: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13923-EU-emissions-trading-system-update-of-the-Verification-and-Accreditation-Regulation_en

[6] 2023. "ISCC Press Release July 27, 2023." *International Sustainability & Carbon Certification*

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Routine direct test results are currently used to verify biogenic content under the US EPA's Renewable Fuel Standard (RFS), California's Low Carbon Fuel Standard (LCFS), Oregon's Clean Fuels Program, Canada's Clean Fuel Regulations (CFR) and the EU's Renewable Energy Directive (RED). All of these programs except the EU RED specifically require the carbon-14 standard ASTM D6866, while the EU RED accepts ASTM D6866 or its European equivalents. ASTM D6866 is also required for prominent third-party verification programs, most notably the Roundtable on Sustainable Biomaterials (RSB).[7] Testing requirements allow clean fuel programs to exclusively incentivize the renewable portion of fuels. This is especially important given the recent history of attempted fraud in existing transportation fuel decarbonization programs.

Any program to promote low-carbon liquid fuels in Albania should specifically require direct biogenic testing for any fuels produced from co-processing and also apply to biogas, hydrocarbon by-products, and renewable natural gas (RNG). Current requirements of routine direct testing following ASTM D6866 under similar prominent programs include:

- The US RFS currently requires routine direct testing following ASTM D6866 for fuels produced from co-processing, municipal solid waste (MSW) biogas & renewable natural gas (RNG).[8]
- California's LCFS requires routine direct testing for fuels produced from co-processing and recommends for fuels produced from MSW.[9]
- Oregon's CFP requires routine direct testing following the protocols of the US RFS third-party engineering reviews.[10]
- Canada's CFR requires routine direct testing for any fuels produced from co-processing and their co-products.[11]
- The EU's RED requires routine direct testing for any fuels produced from co-processing or biogas & renewable natural gas (RNG).[12]

What is Biogenic Testing (Carbon-14)?

Carbon-14 analysis is a reliable method used to distinguish the percentage of biobased carbon content in a given material. The radioactive isotope carbon-14 is present in all living organisms and recently expired material, whereas any fossil-based material that is more than 50,000 years old does not contain any

[7] 2023. "RSB Standard for Advanced Fuels." *Roundtable on Sustainable Biomaterials (RSB)*

[8] 2023. "40 CFR Parts 80 and 1090– Renewable Fuel Standard (RFS) Program: Standards for 2023–2025 and Other Changes." *EPA*

[9] 2020. "Reporting Co-Processing and Renewable Gasoline Emissions Under MRR." *California Air Resources Board*

[10] 2023. "Oregon Clean Fuels Program." *Oregon Department of Environmental Quality*

[11] 2022. "Clean Fuel Regulations: Quantification Method for Co-Processing in Refineries." *Environment and Climate Change Canada*

[12] 2023. "Renewable energy- method for calculating the share of renewables in the case of co-processing." *European Commission*

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carbon-14 content. Since Carbon-14 is radioactive, the amount of carbon-14 present in a given sample begins to gradually decay after the death of an organism until there is no carbon-14 left. Therefore, a radiocarbon dating laboratory can use carbon-14 analysis to quantify the carbon-14 content present in a sample, determining whether the sample is biomass-based, fossil fuel-derived, or a combination.

The analysis is based on standards such as ASTM D6866 and its international equivalents developed for specific end uses, such as the European standard ISO 21644. ASTM D6866 is an international standard developed for measuring the biobased carbon content of solid, liquid, and gaseous samples using radiocarbon dating.[13] There are also many specific international standards based on the use of direct Carbon-14 testing, such as ISO 21644, which is a European standard developed for measuring the biogenic carbon content of waste derived fuels as a fraction of total carbon content.[14]

Carbon-14 analysis yields a result reported as % biobased carbon content. If the result is 100% biobased carbon, this indicates that the sample tested is completely sourced from biomass material such as plant or animal byproducts. A result of 0% biobased carbon means a sample is only fossil fuel-derived. A sample that is a mix of both biomass sources and fossil fuel sources will yield a result that ranges between 0% and 100% biobased carbon content. Carbon-14 testing has been incorporated into several regulations as the recommended or required method to quantify the biobased content of a given material.

ASTM D6866 Method B - The Most Reliable Method

Carbon-14 is a very well-established method which has been in use by many industries (including the fossil fuel industry) and academic researchers for several decades.

Carbon-14 measurements done by commercial third party testing is robust, consistent, and with quantifiable accuracy/precision of the carbon-14 amount under **ASTM D6866 method B**. The EN 16785 is the only standard that allows a variant of the Mass Balance (MB) method of 'carbon counting' under EN 16785-2. The EN 16785-1 requires that the biocarbon fraction be determined by the carbon-14 method. However, when incorporating this EN 16785 method, certification schemes like the "Single European Bio-based Content Certification" **only** allow the use of EN 16785-1 due to its reliability and the value of a third-party certification. http://www.biobasedcontent.eu/en/about-us/

In ASTM D6866 method B, the carbon-14 result is provided as a single numerical result of carbon-14 activity, with graphical representation that is easily understood by regulators, policy

[13] 2021. "Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis." *ASTM International (D6866-21)*

[14] 2021. "ISO 21644:2021 Solid recovered fuels: Methods for the determination of biomass content." *International Standardization Organization*

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makers, corporate officers, and more importantly, the public. The overwhelming advantage of carbon-14 is that it is an independent and standardized laboratory measurement of any carbon containing substance that produces highly accurate and precise values. In that regard, it can stand alone as a quantitative indicator of the presence of biobased vs. petroleum feedstocks. When carbon-14 test results are challenged, samples can be rapidly remeasured to verify the original reported values (unlike mass balance).

The quantification of the biobased content of a given product can be as low as 0.1% to 0.5% (1 relative standard deviation – RSD) based on Instrumental error for Method B (AMS). This error is exclusive of indeterminate sources of error in the origin of the biobased content, and manufacturing processes. As such a total error of +/-3% (absolute) has been assigned to the reported Biobased Content to account for determinate and indeterminate factors.[15]

It is also important that the program should always require ASTM D6866 Method B, rather than allow Method C for any use. Where ASTM D6866 Method B uses the AMS Instrument to measure ^{14}C, Method C uses Liquid Scintillation Counting (LSC). In Method B, the AMS Instrument directly measures the ^{14}C isotopes. However, in Method C, scintillation molecules indirectly absorb the beta molecules that release with the decay of ^{14}C and convert the energy into photons which are measured proportionally to the amount of ^{14}C in the sample. Since Method B directly measures the ^{14}C isotopes and Method C measures them indirectly, Method B is significantly more precise and should be prioritized in regulations.[16] LSC measurements, like those used in Method C, are commonly used as an internal testing tool when samples are limited and accuracy does not need to be extremely high.

About Beta Analytic

Beta Analytic was among the originators of the use of Accelerator Mass Spectrometry (AMS) for the ASTM D6866 biobased / biogenic testing standard using Carbon-14 to distinguish renewable carbon sources from petroleum sources. Beta began testing renewable content in 2003 at the request of United States Department of Agriculture (USDA) representatives who were interested in Beta's Carbon-14 capabilities for their BioPreferred® Program (www.biopreferred.gov). At their request, Beta joined ASTM under subcommittee D20.96. Beta's previous president, Darden Hood, was positioned as a technical contact for the USDA and within 3 months completed the ASTM D6866-04 standard. The Carbon-14 technique is now standardized in a host of international standards including ASTM D6866, CEN 16137, EN 16640, ISO 16620, ISO 19984, BS EN ISO 21644:2021, ISO 13833 and EN 16785. Carbon-14 analysis

[15] 2021. Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis. *ASTM International (D6866-21).* pp 1-19. doi: 10.1520/D6866-21.

[16] 2022. "Testing the methods for determination of radiocarbon content in liquid fuels in the Gliwice Radiocarbon and Mass Spectrometry Laboratory." *Radiocarbon*

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can be used on various types of samples (gas, liquids and solids). Beta Analytic continues to be a technical contact for ASTM D6866 with current president Ron Hatfield and is involved with all their latest ASTM D6866 versions.

The Carbon-14 standardized method is also incorporated in a variety of regulatory programs including the California AB32 program, US EPA GHG Protocol, US EPA Renewable Fuels Standard, United Nations Carbon Development Mechanism, Western Climate Initiative, Climate Registry's Greenhouse Gas Reporting Protocol and EU Emissions Trading Scheme.

We are currently technical experts on Carbon-14 in the following committees:

ASTM D6866 (D20.96) Plastics and Biobased Products (Technical Advisor)
ASTM (D02.04) Petroleum Products, Liquid Fuels and Lubricants (Technical Advisor)
ASTM (061) US TAG to ISO/TC 61 Plastics (Technical Expert)
USDA BioPreferred Program TAC (Technical Advisor)
ISO/TC 61/SC14/WG1 Terminology, classifications, and general guidance (Technical Expert)
CEN/TC 411 Biobased Products
CEN/TC 411/WG 3 Biobased content
CEN/TC 61/SC 14/WG 1 Terminology, classifications, and general guidance (Technical Expert)

ISO/IEC 17025:2017 Accredited Laboratory

To ensure the highest level of quality, laboratories performing ASTM D6866 testing should be ISO/IEC 17025:2017 accredited or higher. This accreditation is unbiased, third party awarded and supervised. It is unique to laboratories that not only have a quality management program conformant to the ISO 9001:2008 standard, but more importantly, have demonstrated to an outside third-party laboratory accreditation body that Beta Analytic has the technical competency necessary to consistently deliver technically valid test results. The ISO 17025 accreditation is specifically for natural level radiocarbon activity measurements including biobased analysis of consumer products and fuels, and for radiocarbon dating.

Required tracer-free facility for Carbon-14

For carbon-14 measurement to work, be accurate, and repeatable, the facility needs to be a tracer-free facility, which means artificial/labeled carbon-14 is not and has never been handled in that lab. Facilities that handle artificial carbon-14 use enormous levels relative to natural levels and it becomes ubiquitous in the facility and cross contamination within the facility, equipment and chemistry lines is unavoidable. Results from a facility that handles artificial carbon-14 would show elevated renewable contents (higher pMC, % Biobased / Biogenic values), making those results invalid. Because of this, Federal contracts and

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agency programs (such as the USDA BioPreferred Program) require that AMS laboratories must be 14C tracer-free facilities in order to be considered for participation in solicitations.

To learn more about the risks associated with testing natural levels Carbon-14 samples in a facility handling artificially enhanced isotopes please see the additional information provided after this comment.

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