ISO/IEC 17025:2017-Accredited Testing Laboratory

Beta Analytic
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
info@betalabservices.com

California Air Resources Board (CARB)
SB 253 Scope 1 and 2 GHG Emissions Reporting | Stakeholder Feedback

This comment recommends the use of the Carbon-14 testing method following standards such as ASTM D6866 Method B to report the biogenic carbon content of fuels and emissions seeking credit for their renewable content under the SB 253 program. Direct biogenic content testing is a well-established best practice for regulating biogenic carbon under prominent successful emissions reporting and fuel decarbonization programs.

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Recommendations for California's SB 253 Emissions Reporting Program

Our recommendation is that California's SB 253 program should require ASTM D6866 Method B test results to verify the renewable content of fuels and emissions claiming to be biogenic. Since the program intends to use "green heat" certificates which can be "issued and traded independently from the energy flows and injection into the distribution grid," any certificates generated for electricity produced by biomass combustion should require ASTM D6866 test results to verify the biogenic CO2 content which can be claimed. This is the only way to guarantee that only the biogenic portion of these emissions are able to generate certificates, and that each certificate directly represents the exact emissions reduction claimed.

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Prioritize Direct Testing Over Calculations

One other important consideration for implementing BECCS and biomass CDR under this program is the need to prioritize direct testing requirements over calculation-based methods like mass balance calculations. This is critical because similar programs in the US are facing lobbying pressure from major petrochemical companies to abandon direct testing and accept mass balance calculations as verification. These calculations consistently overestimate renewable content and would open the door to greenwashing, undermining the success of the program.[1]

Producers and industry lobbying groups favor calculation-based approaches such as mass balance because they enable facilities to make claims solely based on material inputs in production. These calculations allow producers to assume that all of their biomass inputs end up in their facilities' outputs, despite it 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.[2] By basing their calculations solely on production inputs rather than outputs, these methods systematically over-report the renewable share of fuels and emissions.

Calculation-based approaches also use a system of free allocation, meaning they do not have to guarantee that there is any renewable content in a given sample. This reliance on free allocation creates the potential for double-counting of renewable content, leaving emission reduction programs susceptible to a high risk of greenwashing and fraud. For example, this threat is highlighted by the recent mass balance fraud challenges faced by the ISCC regarding fraudulent biodiesel submissions from China, which "caused a dramatic fall in biodiesel prices in European markets" in July 2023.[3] In response to this situation, the EU quickly updated the RED's co-processing rules to uniformly require direct testing, including to verify the calculations of producers choosing to use calculation based approaches.[4]

Notably, California Attorney General Rob Bonta filed a lawsuit against ExxonMobil in September 202,4, claiming that the oil major "deceptively" promoted chemical recycling as a solution to the plastic crisis, citing their use of mass balance calculations such as ISCC Plus.[5] That lawsuit directly challenges the standard's use of ISCC's free allocation method as a system designed to enable greenwashing.[6] This is the same issue facing the biofuels industry from ISCC certifications and other alternative approaches. California's lawsuit followed a ProPublic investigation published in June 2024, which found that products advertised as 30% recycled through mass balance often contained less than 1% recycled content.[7]

[1] 2006. "Determining the modern carbon content of biobased products using radiocarbon analysis." *Bioresource Technology*, 97(16), 2084-2090.
[2] 2006. "Determining the modern carbon content of biobased products using radiocarbon analysis." *Bioresource Technology*, 97(16), 2084-2090.
[3] 2023. "ISCC Press Release July 27, 2023." *International Sustainability & Carbon Certification*
[4] 2023. "Renewable energy- method for calculating the share of renewables in the case of co-processing." *European Commission*
[5] 2024. "The People of the State of California v. Exxon Mobil Corporation." *Superior Court of the State of California*
[6] 2024. "ExxonMobil Accused of "Deceptively" Promoting Chemical Recycling as a Solution for the Plastics Crisis." *ProPublica*
[7] 2024. "Biden EPA Rejects Plastics Industry's Fuzzy Math That Misleads Customers About Recycled Content." *ProPublica*

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The SB 905 program is an important first step toward implementing CCS in California. By adding provisions for biogenic CCS in this program, CARB could promote the most carbon-efficient practices that can be enabled by this technology, opening the door for significantly carbon-negative projects. The best way to regulate BECCS projects and verify their biogenic CO_2 claims is to require routine direct testing following ASTM D6866 Method B. Combined with California's current use of biogenic testing in the LCFS and Cap-and-Trade programs, this data could enable CARB to track biogenic carbon throughout a circular supply chain in which it is sourced from biomass feedstocks, used to produce renewable fuels, combusted and captured as biogenic CO2, and sequestered back into soil to produce biomass feedstocks.

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 carbon-14 content. Since Carbon-14 is radioactive, the amount of carbon-14 present in a given sample begins to gradually decay, through a series of half-lives, 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 ISO 13833. ASTM D6866 is an international standard developed for measuring the biobased carbon content of solid, liquid, and gaseous samples using radiocarbon dating.[8] There are also many international standards based on the specific use of direct Carbon-14 testing, such as ISO 13833, which is an international standard developed for measuring the biogenic carbon content of CO_2 stationary sources emissions.[9]

Carbon-14 analysis yields a result reported as percent (%) 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

[8] 2021. "Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis." *ASTM International (D6866-21)*
[9] 2013. "ISO 13833:2013 Stationary source emissions: Determination of the ratio of biomass (biogenic) and fossil-derived carbon dioxide." *International Organization for Standardization*

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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 using AMS is the "gold standard" for determining biogenic carbon content of solids, liquids, and gases.

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 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, carbon-14 can stand alone as a quantitative indicator of the presence of biobased vs. petroleum feedstocks and in complex mixtures and products. When carbon-14 test results are challenged, samples can be rapidly remeasured to verify the original reported values (unlike mass balance).

It is critical that testing be required to follow ASTM D6866 Method B. ASTM D6866 Method B uses Accelerated Mass Spectrometry (AMS), while 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.[10] LSC calculations 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.

[10] 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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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 as well as sample heterogeneity.[11]

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 P.G., 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 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 Mr. Ronald E. 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.

Beta Analytic currently serves as 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

[11]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.

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

Areas where cross-contamination might occur include but are not limited to; biomedical or nuclear reactors, isotope enrichment / depletion columns, water, soil, plant, or air samples collected near or at biomedical / nuclear reactor sites, medical, industrial, or hazardous waste sites, samples specifically manipulated to study the uptake / fractionation of stable isotopes due to biological or metabolic processes. 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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