



INNOVHUB
STAZIONI SPERIMENTALI
PER L'INDUSTRIA

innovazione e ricerca

Determinazione del ^{14}C nei prodotti
petroliferi: sviluppo della normativa e
confronto tra tecniche analitiche

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Definizioni



'Bio-based products'

Products which are wholly or partly derived from biomass



LCA



Biodegradability



Sustainability

DIRETTIVA (UE) 2023/2413 (RED III)



Regolamento delegato (UE) 2023/1640 (coprocessing)

Metodologia per determinare la quota di biocarburanti e di biogas per il trasporto derivanti da biomassa trattata con combustibili fossili

Il metodo di prova può essere basato su:

- equilibrio di massa
- bilancio energetico
- rendimento
- radiocarbonio (^{14}C)

Frequenza: almeno una volta ogni 4 mesi o quando i parametri variano di oltre il 5%

Da applicare periodicamente per verificare il corretto funzionamento



Decisione (UE) 2018/1702 (Ecolabel per i lubrificanti)

Se si usa il termine «derivante da biomassa» o «bio-lubrificante», il contenuto minimo di carbonio derivante da biomassa nel prodotto finale è pari al 25 %

Per dimostrare la conformità sono previste le norme:

EN 16807, ASTM D6866, DIN CEN/TS 16137 (SPEC 91236), **EN 16640** o EN 16785-1.



bio-based content
(C, O, H, N)

EN 16785-1 includes the amount of carbon, oxygen, hydrogen and nitrogen derived from biomass (considered to be derived from biomass if they are bound to carbon that has been derived from biomass). Evaluation of combined experimental radiocarbon and elemental analysis results.

bio-based carbon content
(C)

ASTM D6866: expressed as a fraction of the total organic carbon, TOC → excluding any inorganic (fossil) carbon present in the product

EN 16640: expressed as a fraction of sample mass or as a fraction of the total carbon content.

All three standards are based on the same principle that ^{14}C content is a tracer of recently produced bio-based products.

EN 16640	Prodotti a base biologica - Contenuto di carbonio di origine biologica - Determinazione del contenuto di carbonio di origine biologica usando un metodo basato sul radiocarbonio 14C
EN 16785-1	Prodotti a base biologica - Contenuto a base biologica - Parte 1: Determinazione del contenuto a base biologica utilizzando l'analisi al radiocarbonio e l'analisi elementare
ASTM D6866	Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
ISO 16620-2	Plastics — Biobased content - Determination of bio-based content – Part 2: Test methods for the determination of bio-based carbon content
DIN 51637:2014	Liquid petroleum products - Determination of the biobased hydrocarbon content in diesel fuels and middle distillates using liquid scintillation method
EN ISO 21664	Combustibili solidi secondari - Metodi per la determinazione del contenuto di biomassa
UNI/TS 11461:2012	Impianti di co-combustione, incenerimento e co-incenerimento - Determinazione della frazione di energia rinnovabile prodotta dall'impianto mediante la misura del 14C al camino



prEN 16640:2026

Bio-based products - Bio-based carbon content - Determination of the bio-based carbon content using the radiocarbon method

WI = 00411021
CEN/TC 411/WG 3

Result of voting

(National Members having abstained are not counted in this vote.)

DISCLAIMER

This voting result is calculated based on IR2, Clause 6.4 'Decisions concerning Standardization Requests and related mandated work'. The counting of the votes of Blue-Type Members (Members from EEA countries) is by default displayed on this voting report. If the voting result is 'pending', the item has to escalate to the Technical Board for final decision in line with CEN-CENELEC Internal Regulations Part.2, clause 6.4. TCs are expected to carry out a preliminary assessment of the voting result so that to provide advice to BTs for an informed decision.

Approved by National Members

National Members approving: 11

National Members disapproving: 0

Number of Members approving: **100.000 % (requirement >= 55 %)**

Weighted percentage of Population approving: **100.000 % (requirement >= 65 %)**

Blue-Type Members approving: 10

Blue-Type Members disapproving: 0

Number of Blue-Type Members approving: **100.000 % (requirement >= 55 %)**

Weighted percentage of EEA (Blue-Type) Population approving: **100.000 % (requirement >= 65 %)**

prEN 16640:2026

Bio-based products - Bio-based carbon content - Determination of the bio-based carbon content using the radiocarbon method

- The saturated-absorption cavity ring-down spectroscopy (SCAR) method has been added. This includes an annex comparing the SCAR method to the accelerator mass spectrometry (AMS) method
- The beta-ionization (BI) method has been removed.
- Reference value for 100 % bio-based carbon is now taken from an ASTM standard.



method A: Liquid scintillation-counter (**LSC**)

A liquid scintillation counter measures β -decay counts of ^{14}C (in counts per minute, cpm) indirectly by measuring the interaction signals of the β particles with scintillation molecules (emission of photons -light- proportional to the decay energy).

indirect determination of the isotope abundance of ^{14}C , through its **emission of beta particles** (interaction with scintillation molecules)
(Annex C)

method B: Accelerator mass spectrometry (**AMS**)

The AMS system measures the carbon isotopes ^{12}C , ^{13}C and ^{14}C of a carbon sample

direct determination of the isotope abundance of ^{14}C
(Annex D)

method C: Saturated-absorption cavity ring-down (SCAR) spectroscopy

The SCAR spectroscopy quantifies the mole fraction of the $^{14}\text{C}^{16}\text{O}_2$ isotopologue within a CO_2 gas sample

indirect determination of the isotope abundance of ^{14}C , through **absorption of infrared photons** from $^{14}\text{CO}_2$ molecules
(Annex E)

Method	Additional requests	ASD	RSD	Duration needed for measurement	Typical carbon mass needed	Equipment costs
Method A (LSC)	- Normal laboratory	5 pMC $\propto \sqrt{F}$	10 % $\propto 1/\sqrt{F}$	2 h to 24 h	> 1g	Low
Method B (AMS)	- Large installation - Graphite conversion device ^a	0,3 pMC $\propto \sqrt{F}$	0,3 % $\propto 1/\sqrt{F}$	10 min to 30 min	< 1 mg	High
Method C (SCAR)	- Normal laboratory - Gas purification device	1 pMC constant	1 % $\propto 1/F$	10 min to 6 h	1 mg to 10 mg	Intermediate
^a A few years ago, compact new AMS equipment became available. In a number of cases, no graphite conversion is required anymore.						

The amount of bio-based carbon in the bio-based product is proportional to its **^{14}C content**

The **^{14}C content** of a bio-based product is determined on the CO_2 produced by the sample combustion

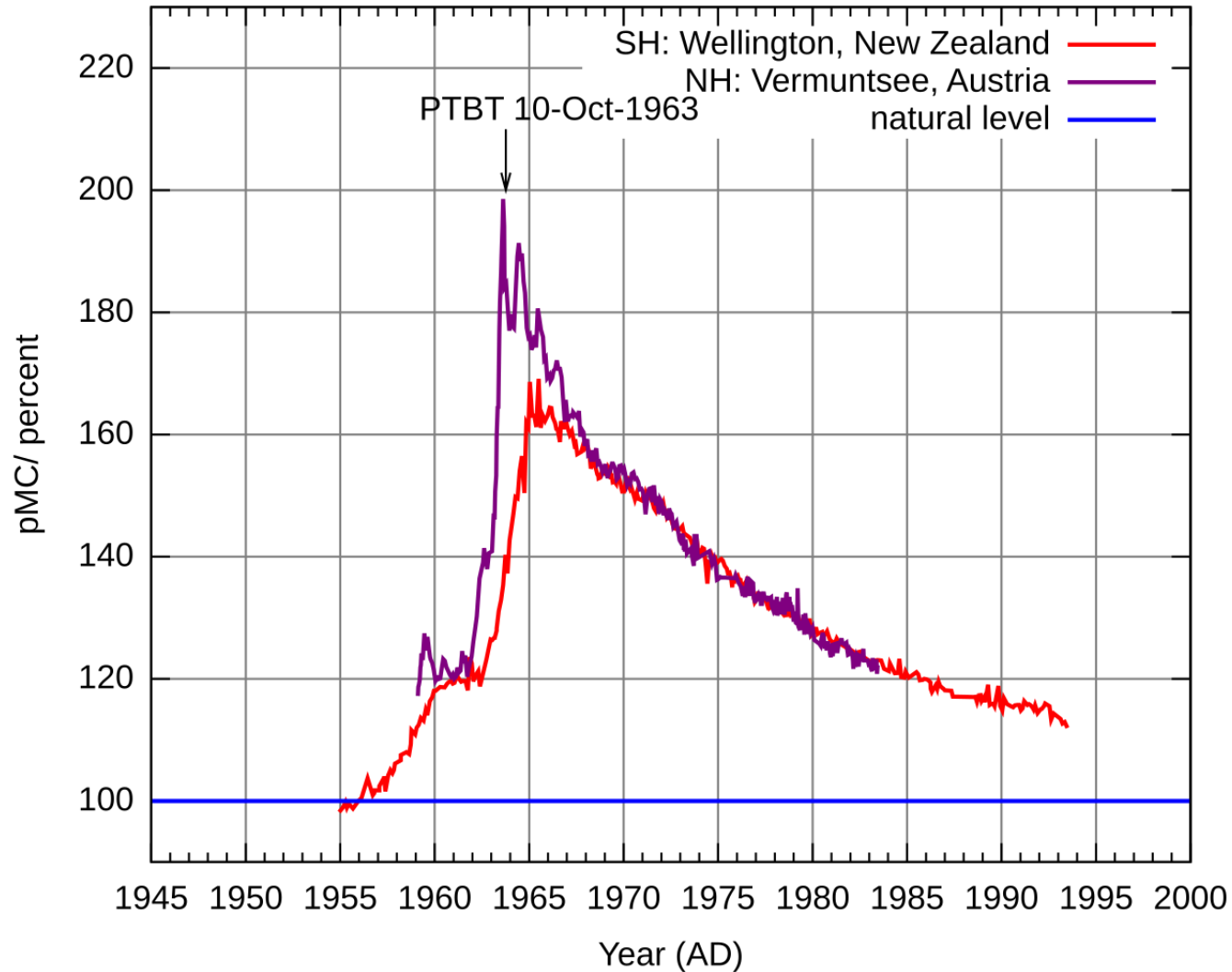
percentage modern carbon (pMC)
normalized and standardized value for the amount of the ^{14}C isotope in a sample, calculated relative to the standardized and normalized ^{14}C isotope amount of oxalic acid standard reference material NIST SRM 4990c

The **pMC value of NIST SRM 4990c** is set at 134,07, being 100 pMC equivalent to a ^{14}C activity of 13,56 dpm/g C

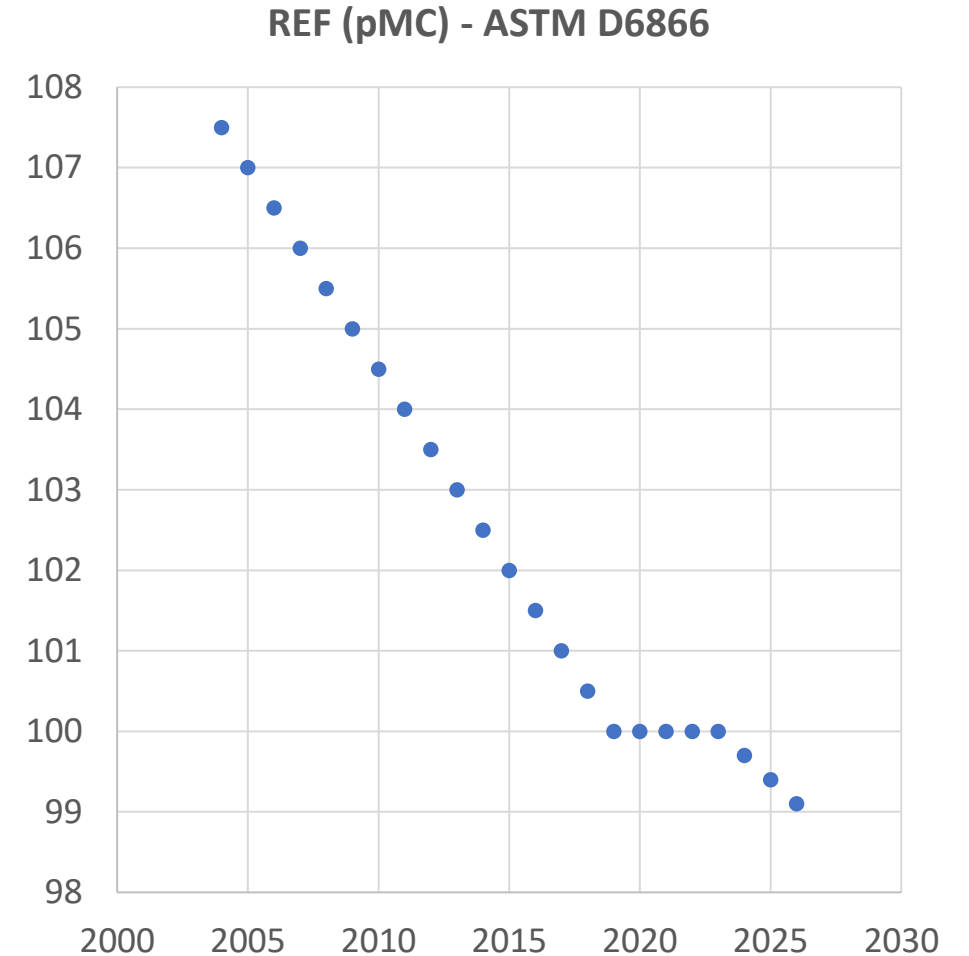
pMC values must be adjusted by an atmospheric correction factor (**REF**) to obtain the true biobased content of the sample. REF is based on the ^{14}C activity in the atmosphere at the time of the testing

bio-based carbon content by total carbon content





<https://en.wikipedia.org/wiki/Carbon-14>

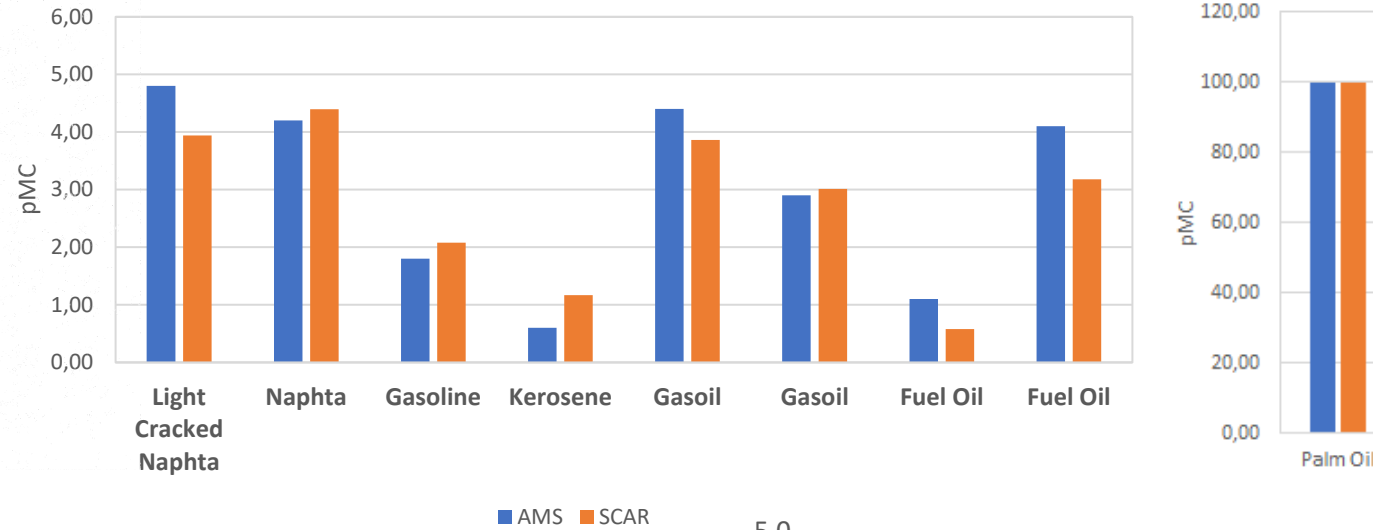


Progetto interno Innovhub

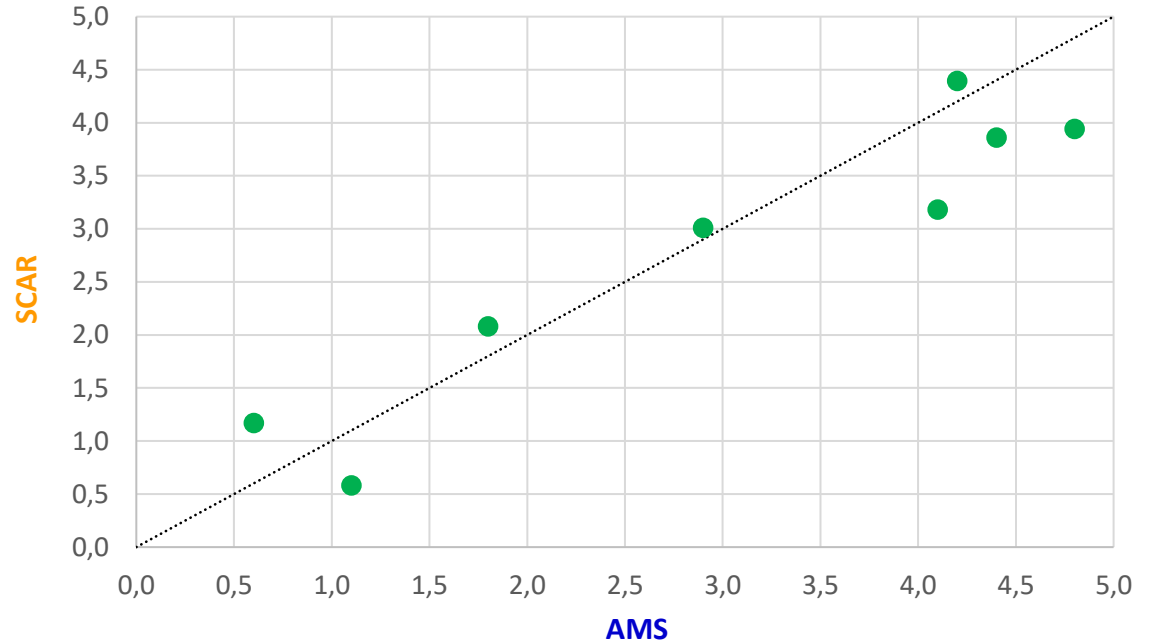


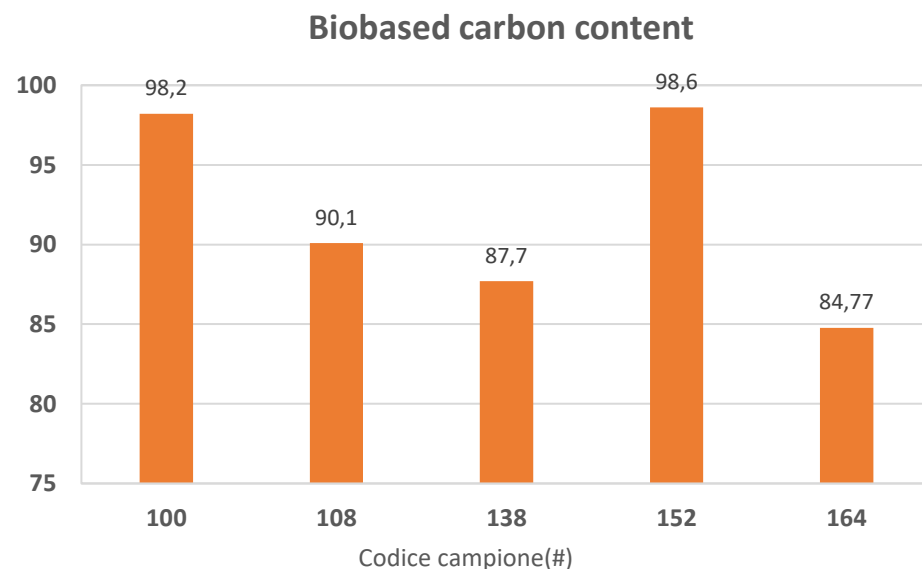
Blind coded

Samples	AMS	SCAR	Valore di formula zione
8 campioni da co-processing	X	X	-
1 campione di olio di palma	X	X	-
5 campioni di HVO	-	X	-
6 miscele HVO/BO	-	X	X
3 miscele FAME/BO	-	X	X
2 miscele EX	-	X	X
1 campione di bioetanolo	-	X	-
1 campione di benzina con "claim bio"	-	X	-
...altri campioni seguiranno...			



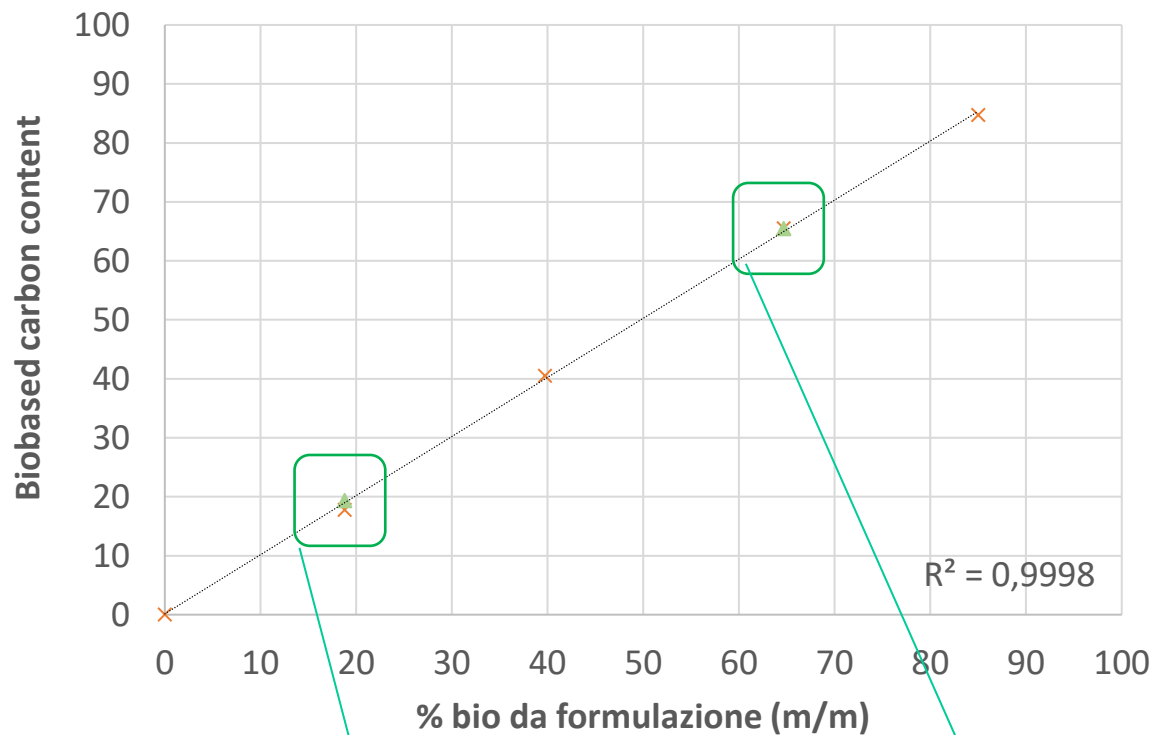
- both techniques can measure low levels of bio-based carbon content
- the two techniques show good agreement





- CIRCOLARE ADM N. 29/2024: dal 1° gennaio 2025, l'HVO (Hydrotreated Vegetable Oil) è classificato in base al nuovo codice doganale:
NC 2710 1942 Oli da Gas – “Con un tenore di carbonio di origine biologica pari ad almeno l'80 % in peso”.
- EN 15940: "Any intentional addition of non-paraffinic material **other than material meeting the EN 590 standard**, FAME, additives and dyes or markers, is not allowed. The resulting blend shall meet all the requirements of the EN 15940 standard."

Test n.1 (SCAR)

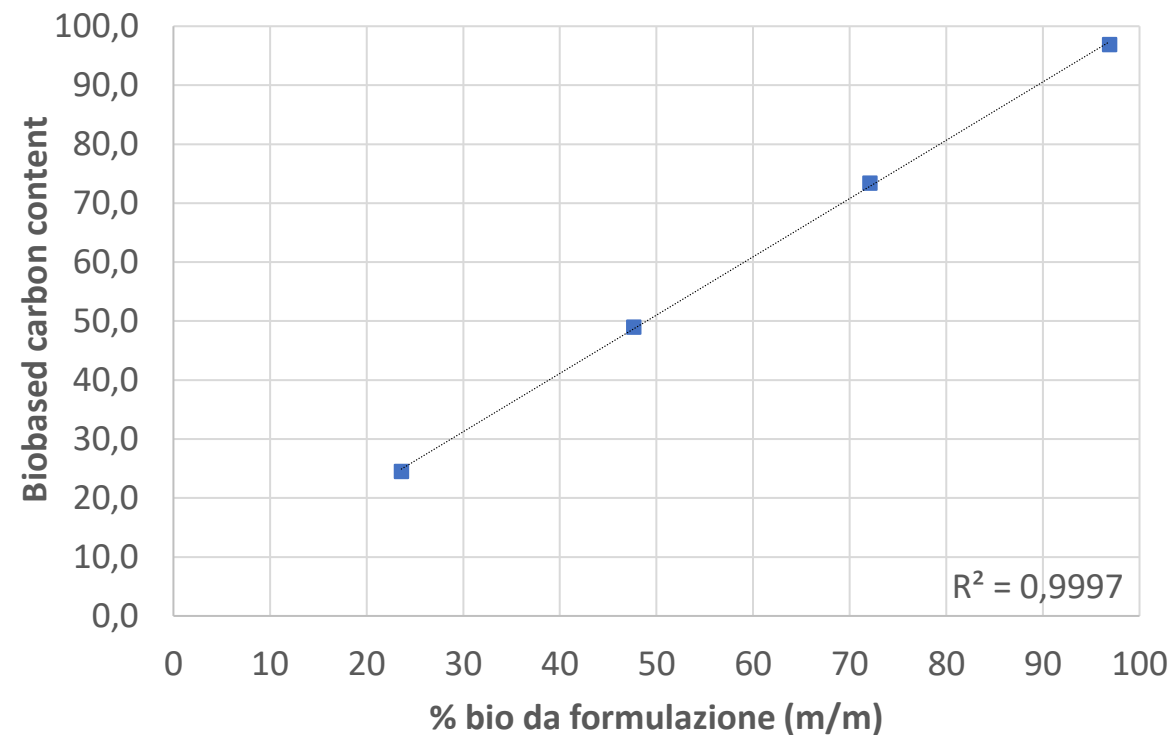


17,8
19,4

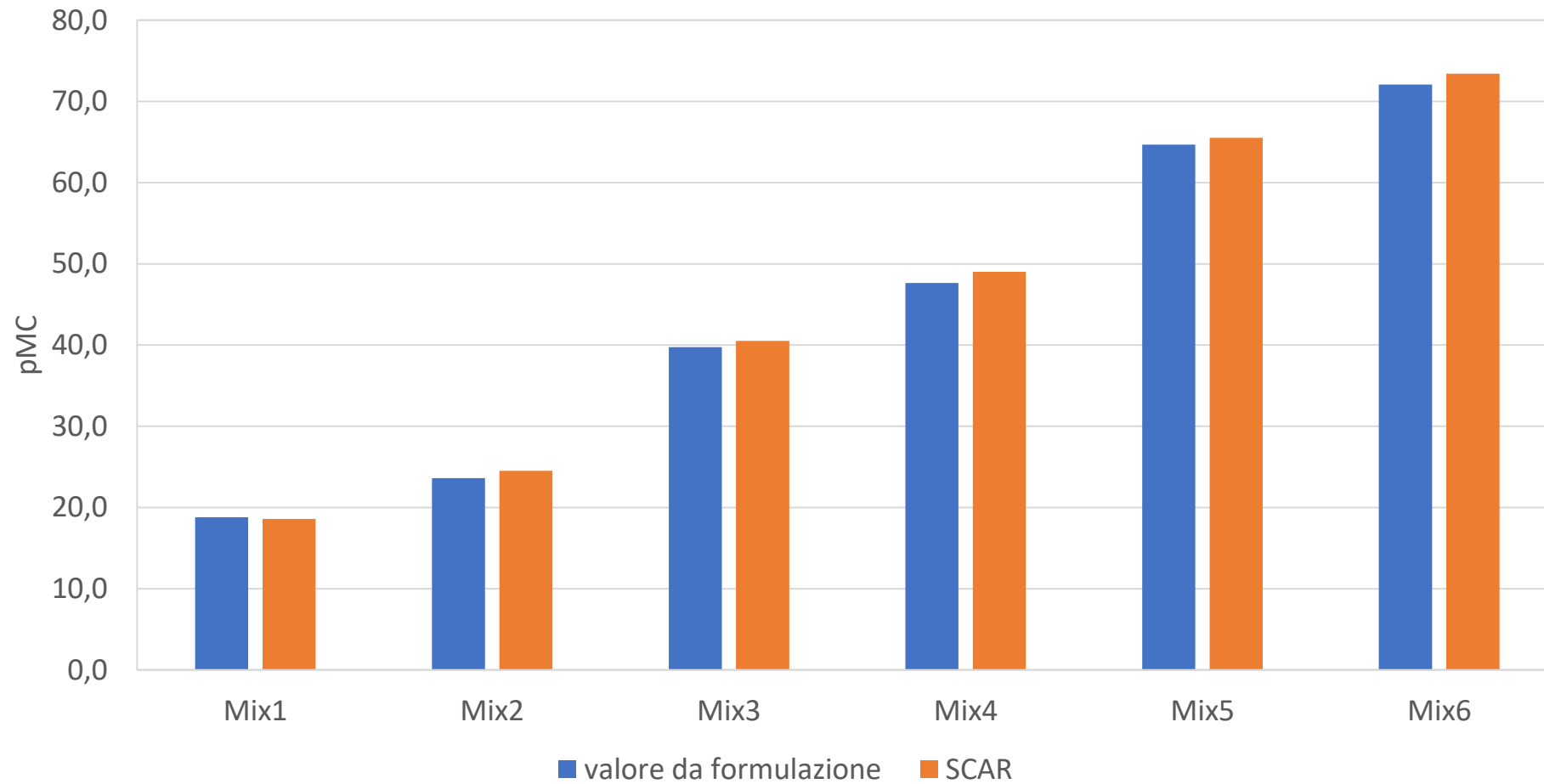
65,5
65,5

Good repeatability

Test n.2 (SCAR)



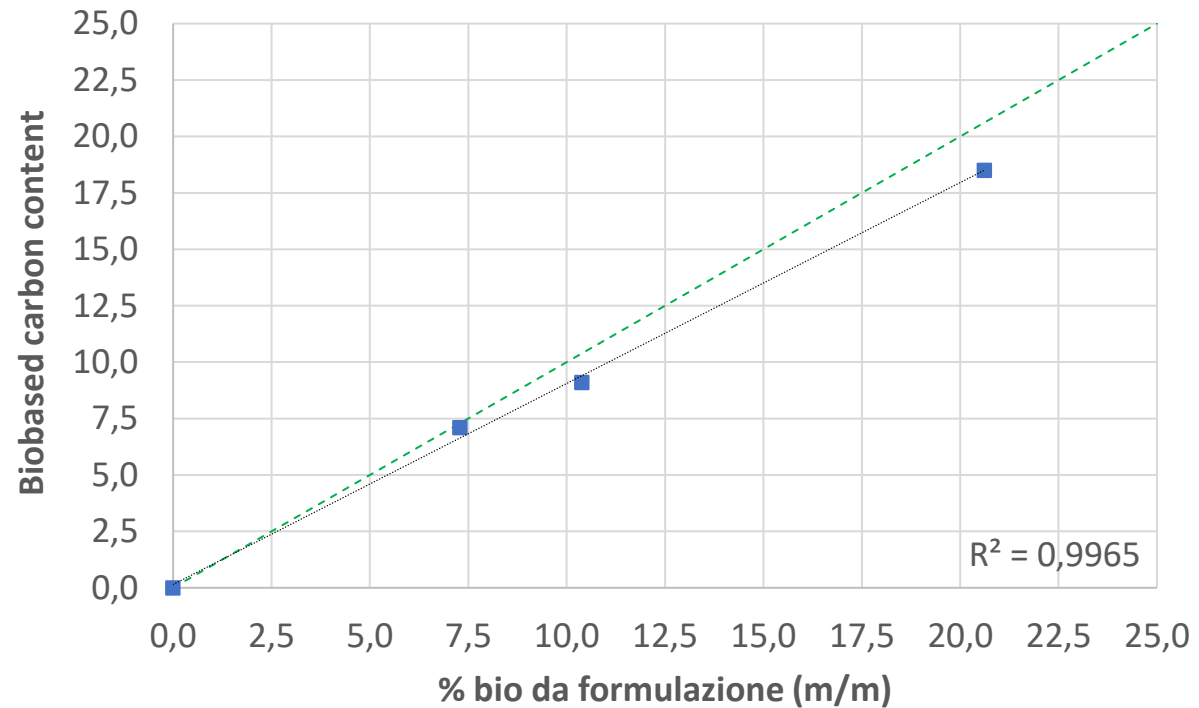
Risultati miscele HVO



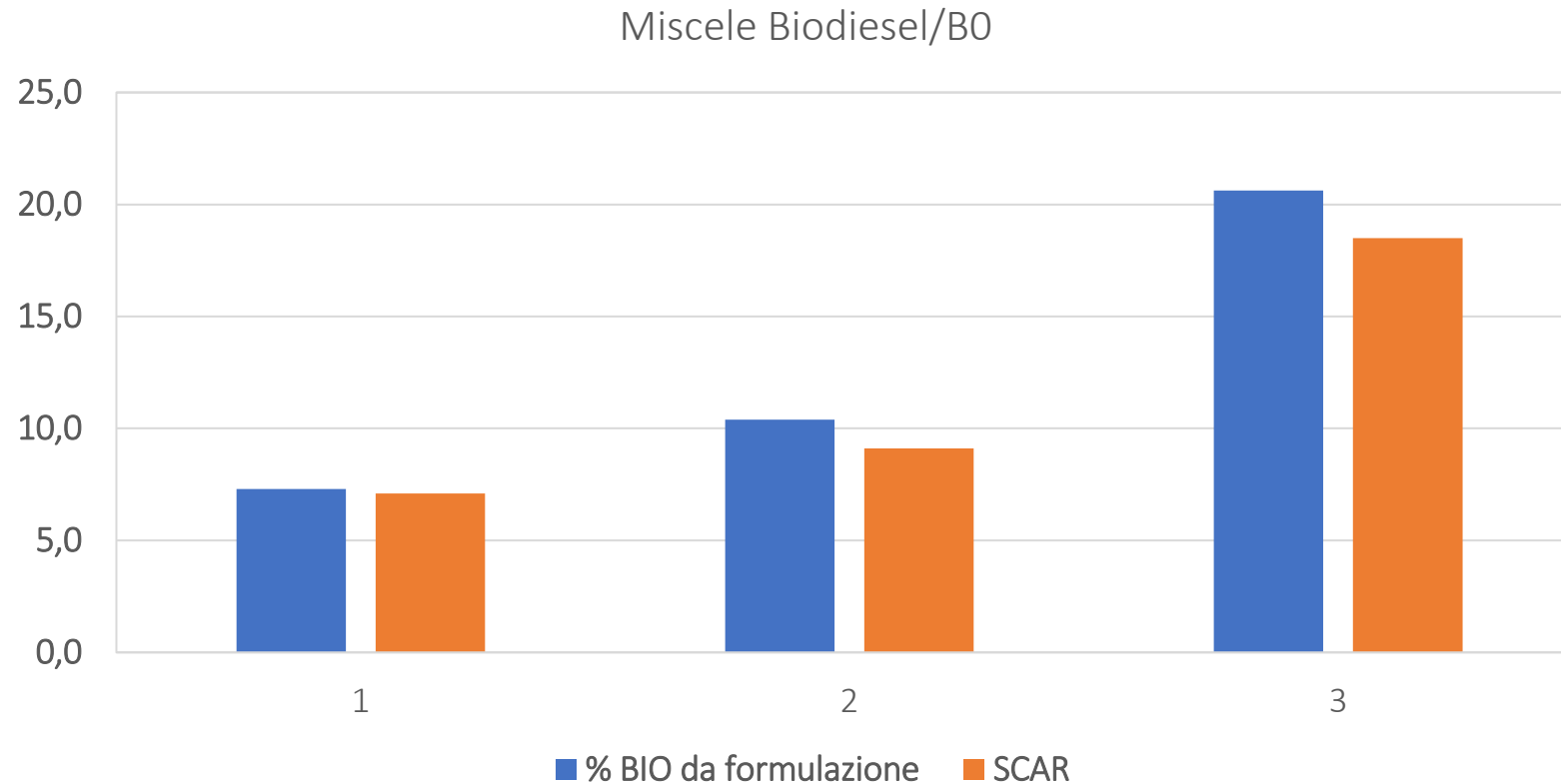
- Excellent agreement with the formulation values

Samples:

- B0
- ~ B7
- ~ B10
- ~ B20



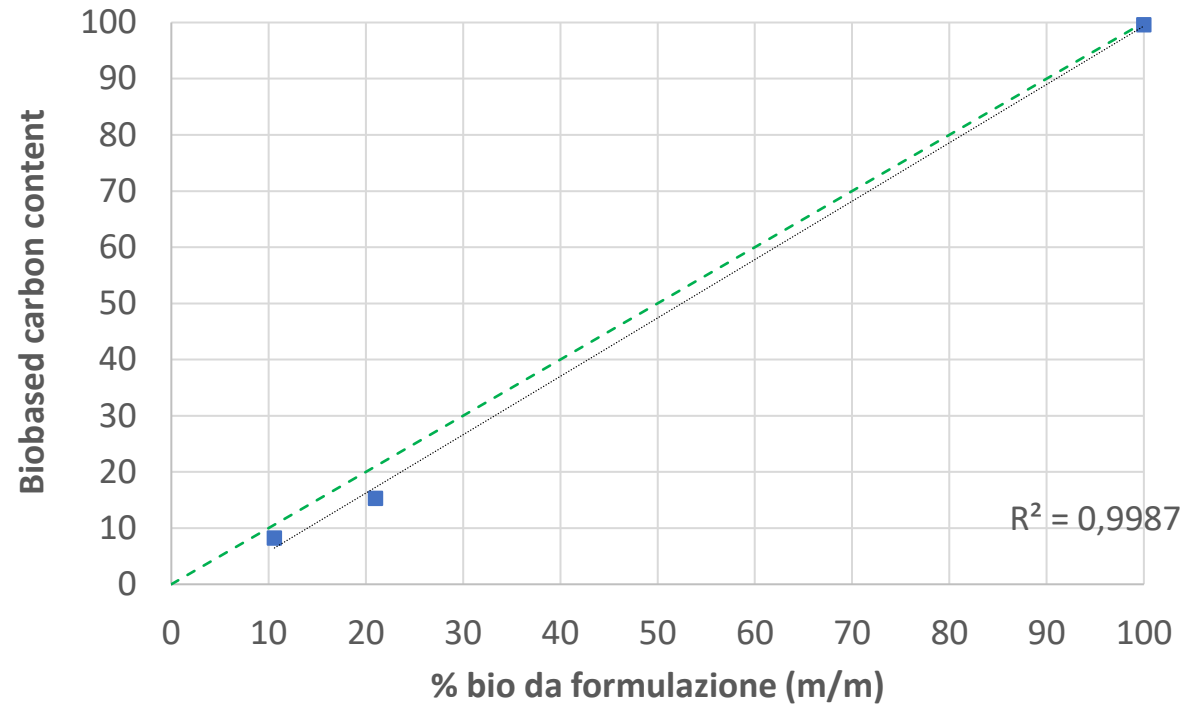
B100: the ^{14}C of pure biodiesel was not tested. Due to the presence of fossil methanol a value of 97% was considered (literature)



- Good agreement with the formulation values, that could be improved by knowing the ^{14}C of pure biodiesel

Samples:

- ~ E10
- ~ E20
- E100



- Good agreement with the formulation values
- Underestimation probably due to bioethanol losses during sampling



	CLAIM	Risultato (SCAR)
Benzina	> 80% sostenibile	82%

prEN 16640

- WG meeting at the end of April to discuss the comments, EN 16640:2026 before the end of the year

CEN/TC 19/WG 24

- Need for biogenic demonstrability method is under discussion
 - Co-processing only to be proven via AMS (expensive, not widely available)
 - Indirect LSC is imprecise for low levels of HVO blending
 - Direct LSC (DIN 51637) lacks precision
 - New SCAR method
 - Liaison with CEN/TC 411