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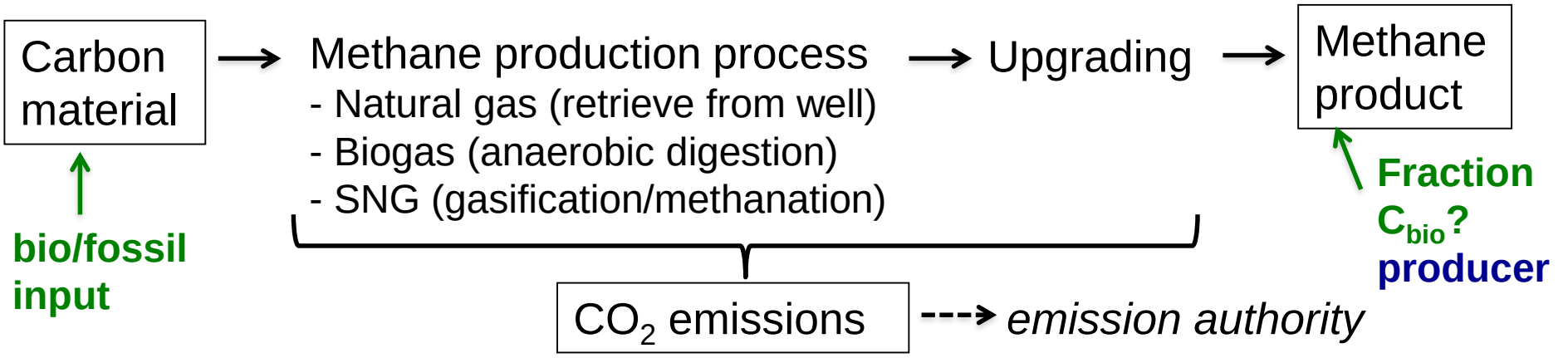
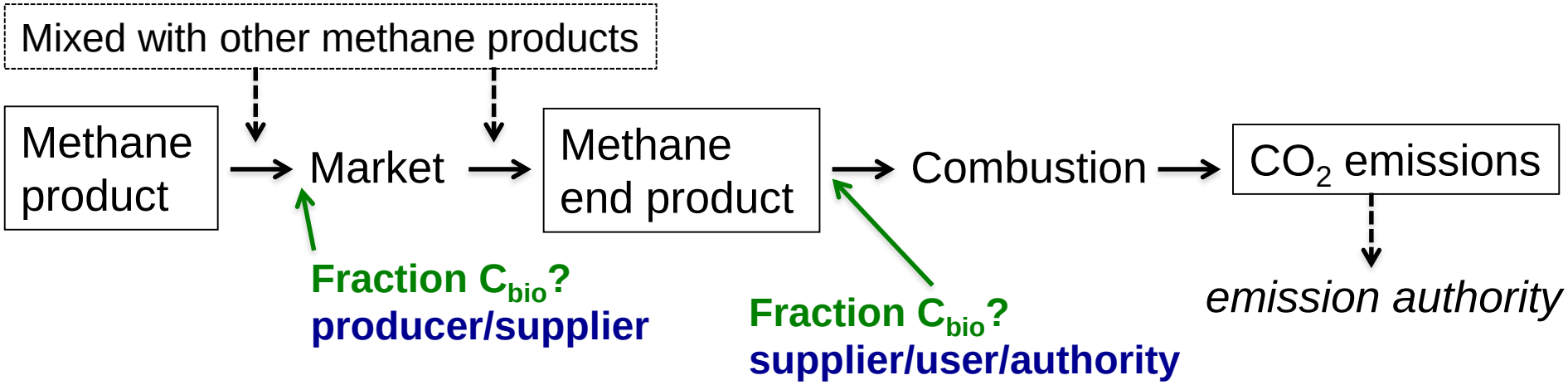
Test method biogenic methane content

Sanne Palstra & Harro Meijer

EMPIR 16ENG05 – WP3.7
(University of Groningen, RISE, VSL)

Verification

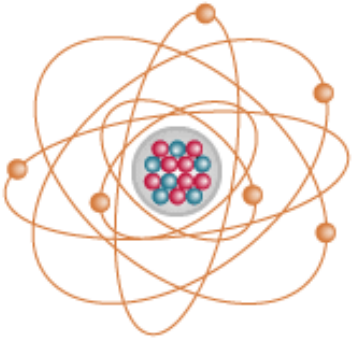




What verification method?

- Distinguish fossil and biogenic carbon
- Independent
- Most specific and independent method:

  → **^{14}C method**

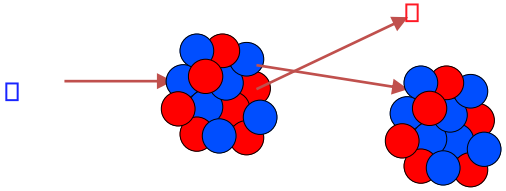


Carbon-14
unstable (radioactive)

^{14}C - basics

› ^{14}C = 'radiocarbon' =  (half-life: 5730 yr)

› Produced in atmosphere by cosmic radiation



$$n + {}^{14}N \Rightarrow p + {}^{14}C \Rightarrow {}^{14}CO_2$$

Natural abundances of carbon isotopes:

^{12}C : ^{13}C : ^{14}C = 99 : 1 : 10^{-10} %C

stable stable

^{14}C - basics

Since 1950s

Pretreatment to pure CO_2 or C

Current measurement techniques (natural level):

- Accelerator Mass Spectrometer (AMS) → Counting ^{14}C atoms
- Liquid scintillation counter (LSC) → Counting decay events

Standardization and inter-comparisons by ^{14}C lab-community

Distinguish biogenic and fossil carbon

Recent atmospheric ^{14}C

No ^{14}C

Calculation of fC_{bio}

$$^{14}C_{sample} = {}^{14}C_{bio} \times fC_{bio} + {}^{14}C_{fossil} \times fC_{fossil}$$

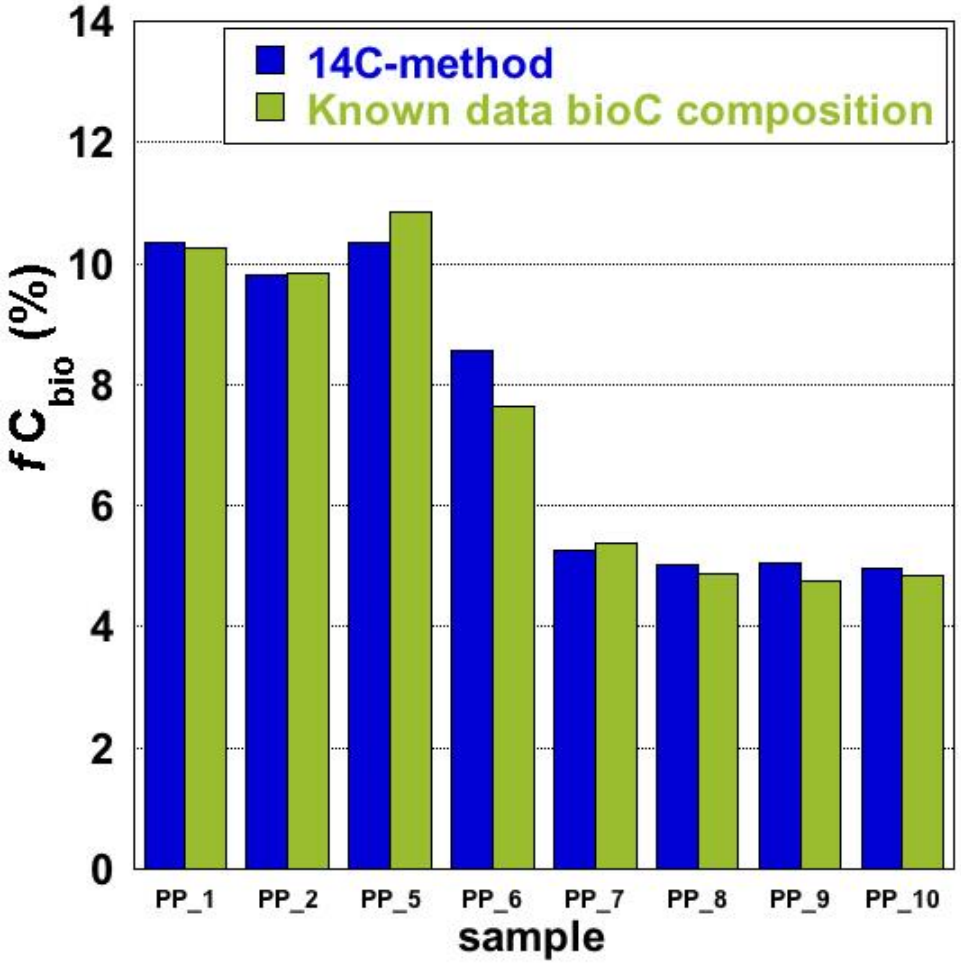
$$fC_{bio} = \frac{^{14}C_{sample}}{^{14}C_{bio}}$$

Example: $^{14}C_{sample}$ = 42 and $^{14}C_{bio}$ = 105

→fC_{bio} = 42 / 105= 0.40

Carbon content sample = 40% biogenic and 60% fossil

Example ^{14}C method; flue gas CO_2



Coal-wood fired power plant

^{14}C method in standards

- ✓ Bio-based products: ASTM 6866 and CEN/TS 16640
- ✓ Waste (SRF): CEN/TS 15440-2
- ✓ Flue gas CO_2: ISO 13833
- ✓ Plastics: ISO 16620-2
- ✓ Rubber: ISO 19984-2
- ✓ **(Bio)gas: Test method ISO standard, draft to be written in EMPIR 16ENG05 (for consideration in ISO/TC193/SC1)**

^{14}C method

1) Define carbon to be investigated

↓

2) Sampling

↓

3) Storage and transport

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4) Pretreatment to CO_2

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5) ^{14}C measurement preparations

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6) ^{14}C measurement & calculation

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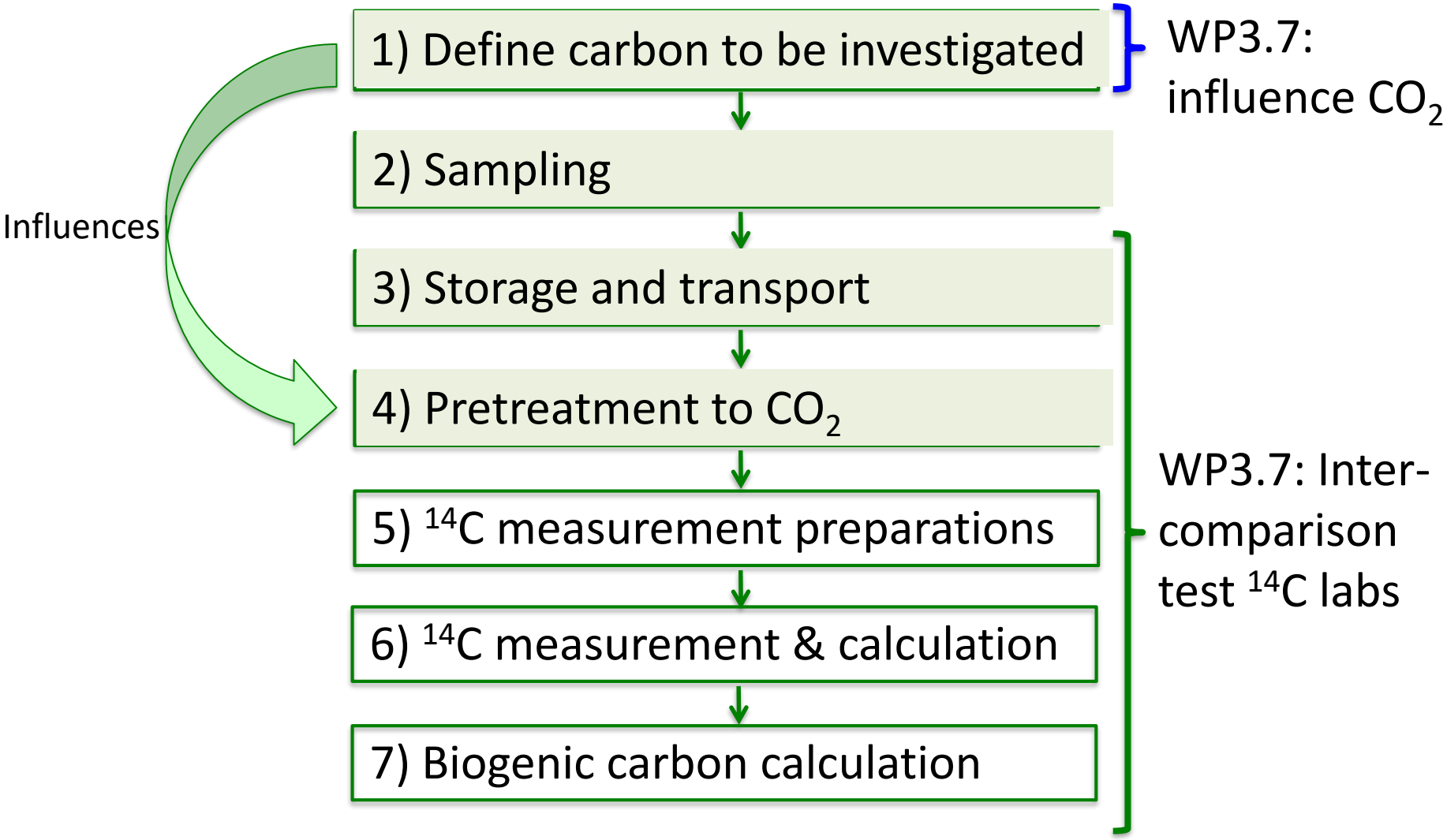
7) Biogenic carbon calculation

^{14}C method – for (blends of) biogas and natural gas



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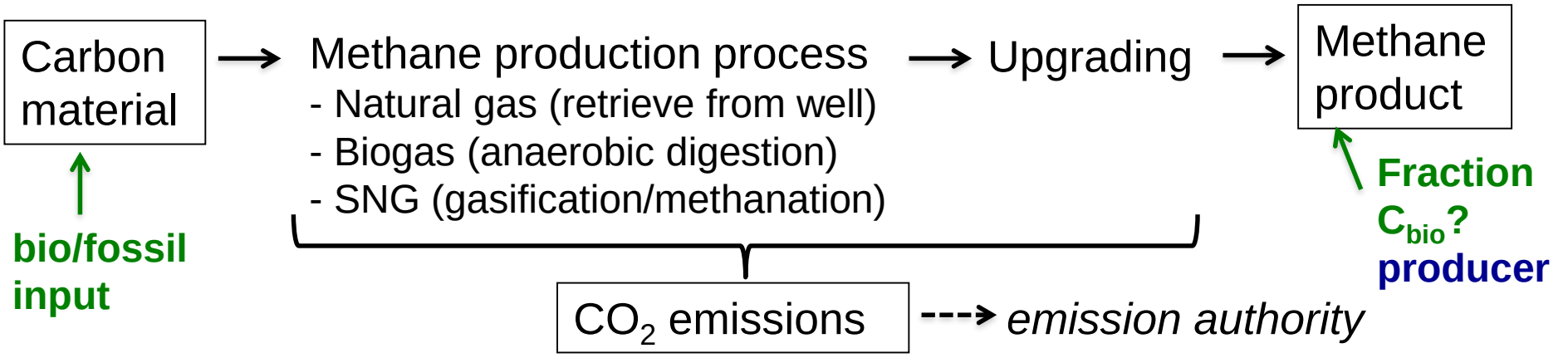
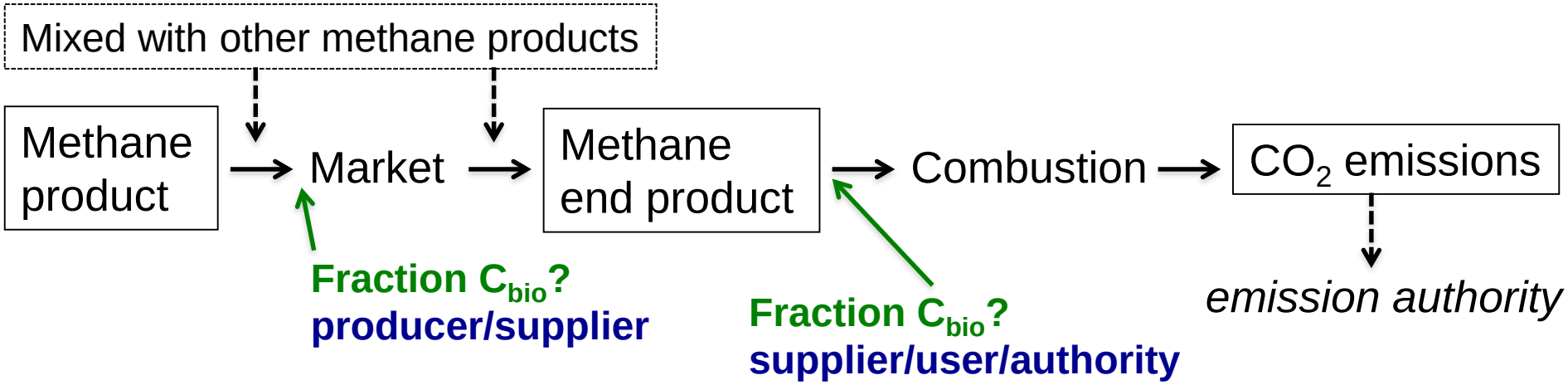
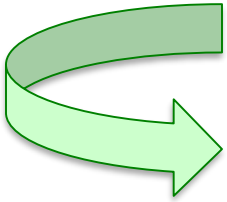




Discussion

Test method for verification of biogenic carbon content in (blends of) biogas and natural gas →



1) Define carbon to be investigated

4) Pretreatment to CO_2

Our proposal: a method in which all carbon-containing gaseous molecules have a share in the final biogenic carbon content.

Question:

Will this answer questions of producers/suppliers/users?
Or should in some cases specific gas components (e.g. CO_2) be excluded?

Summary

^{14}C method: reliable and sensitive method for biogenic carbon content verification.

In application for gases different specific factors should be taken into account. This will be investigated and tested within the current EMPIR project.

More background and information on this topic:

see PhD thesis Sanne W.L. Palstra (University of Groningen, 2016): https://www.rug.nl/research/portal/en/publications/on-14cbased-methods-for-measuring-the-biogenic-carbon-fraction-in-fuels-and-flue-gases(ba0e40d4-6e1c-4373-a03c-4c84a9ff3d55).html