# Bio-based content

## What does it mean and how is it determined?

NVVT Technical symposium, 22 November 2016

Maarten van der Zee

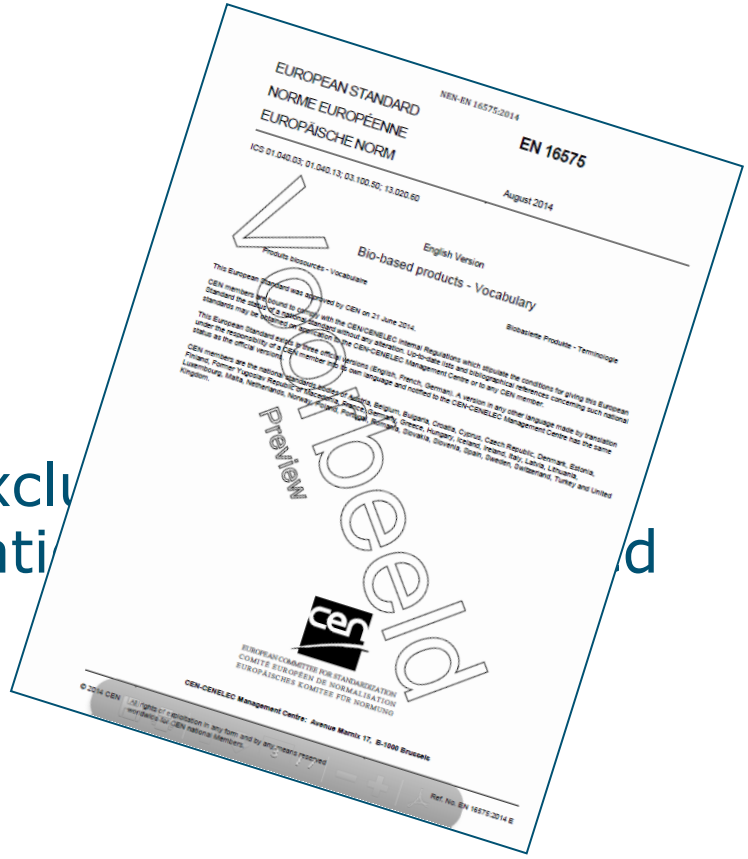
WAGENINGEN
UNIVERSITY & RESEARCH

# Bio-based – what does it mean?

According to EN 16575: Bio-based Products – Vocabulary

- **Bio-based**
  = derived from biomass

- **Biomass**
  = material of biological origin excl
  embedded in geological formati d



# Examples of biomass

Whole or parts of...

- plants
- trees
- algae
- marine organisms
- animals
- micro-organisms
- organic waste

WAGENINGEN
UNIVERSITY & RESEARCH

# Bio-based – what does it mean?

According to EN 16575: Bio-based Products – Vocabulary

- **Bio-based product**

  = product wholly or partly derived from biomass

  - ‘product’ can be an intermediate, material, semi-finished or final product
  - often refers to partly bio-based products

    ⇨ quantification of the bio-based content

# Bio-based – what does it mean?

According to EN 16575: Bio-based Products – Vocabulary

- **Bio-based content**

  = fraction of a product that is derived from biomass

  - Normally expressed as a percentage of the total mass of the product

# Bio-based – what does it mean?

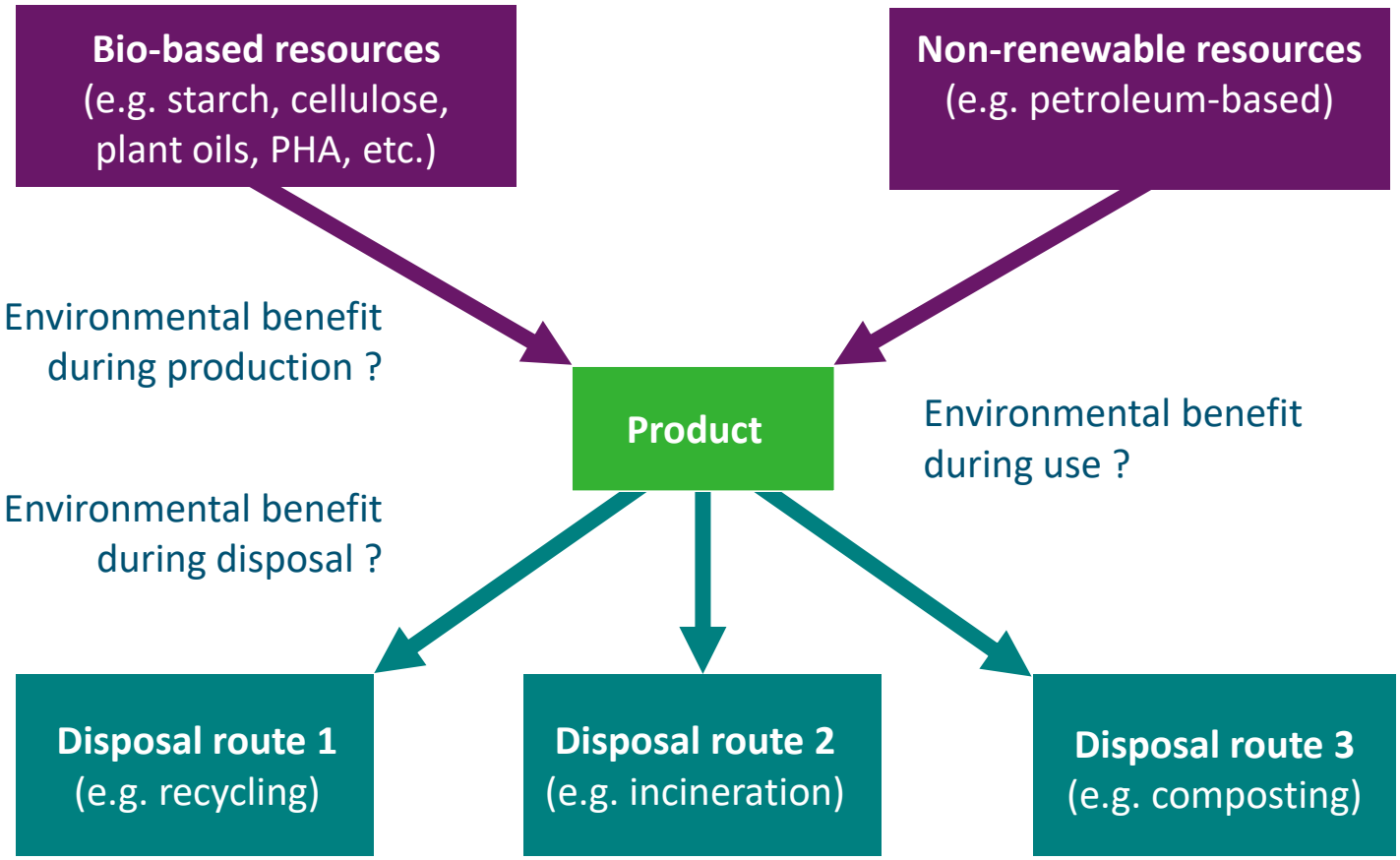
Be aware that **Bio-** is also used to indicate ...

- Biodegradable
- Bioactive
- Antibacterial
- Organically grown
- Biocompatible
- ..... etc.

So avoid terms like ‘bioplastic’, ‘biocoating’, ‘biopaint’

WAGENINGEN
UNIVERSITY & RESEARCH

# Bio-based and sustainability



# Bio-based content

According to EN 16575: Biobased Products – Vocabulary

- **Bio-based content**

  = fraction of a product that is derived from biomass

Calculate ??

Measure ??

# Some background


Develop horizontal standards
for bio-based products

CEN/TC 411, start: Oct. 2011

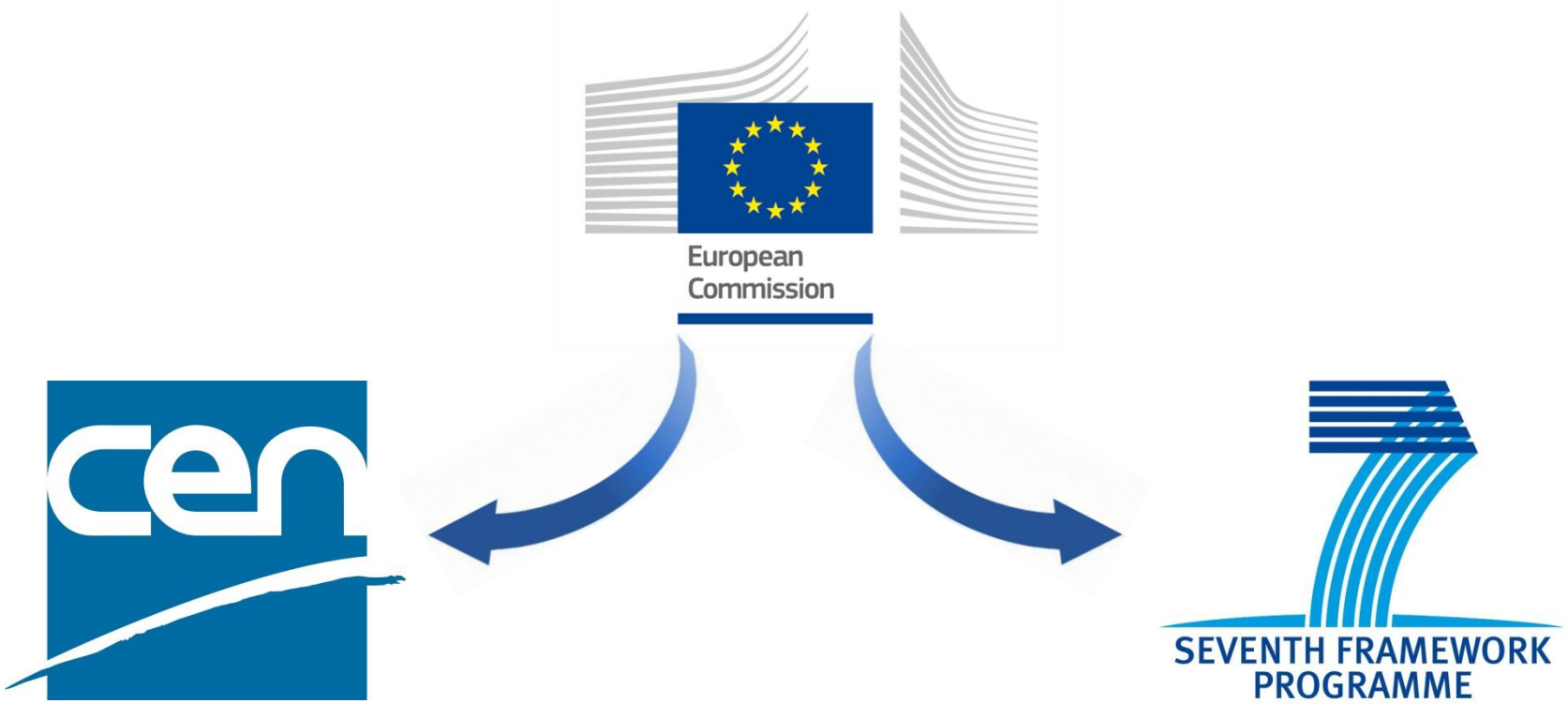
WAGENINGEN
UNIVERSITY & RESEARCH

# CEN/TC 411 'Bio-based products'

- Objective: develop "horizontal standards" for bio-based products, a.o.
  - Consistent terminology
  - Methods for evaluation of bio-based content
  - Address the evaluation of sustainability
  - Address certification and declaration tools
  - Etc.

WAGENINGEN
UNIVERSITY & RESEARCH

# Some background



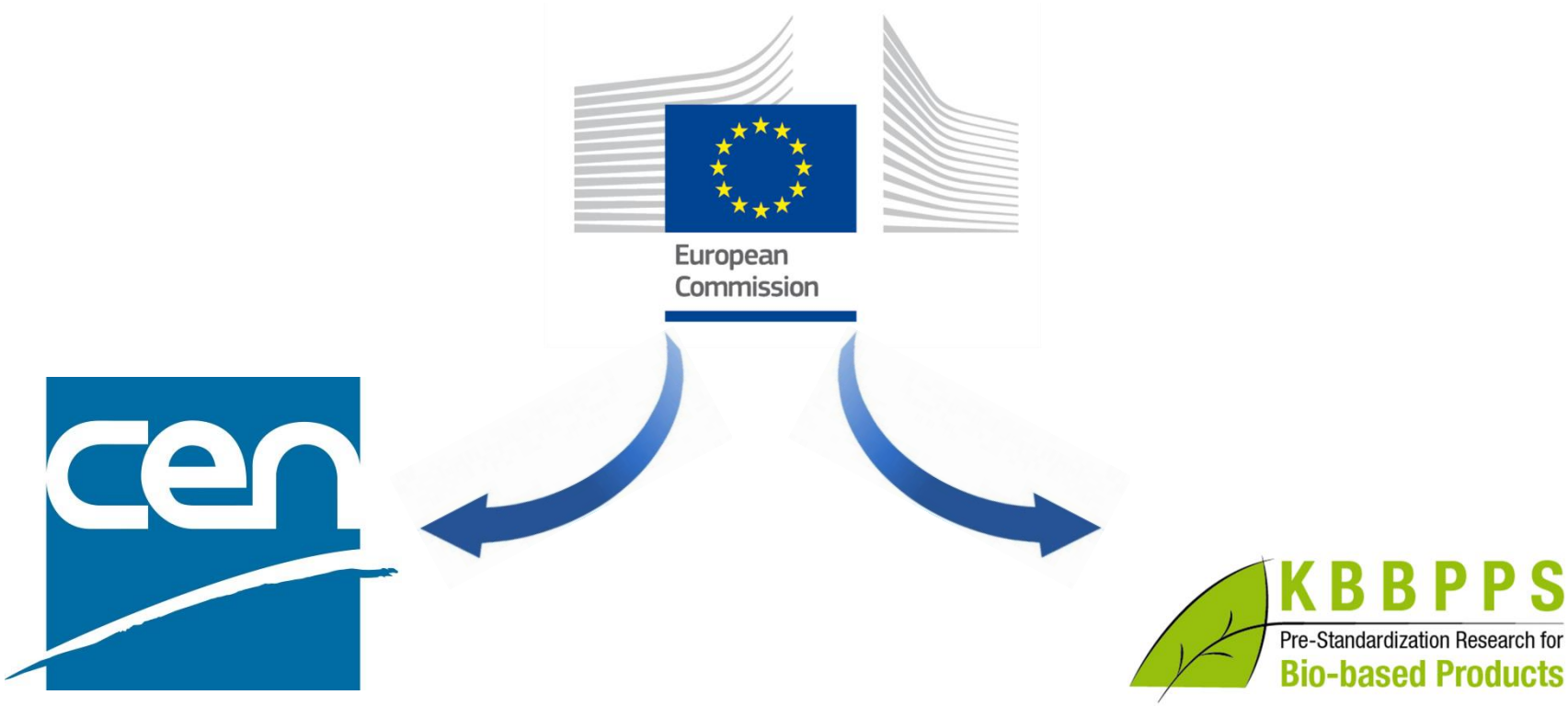

Develop horizontal standards for bio-based products

CEN/TC 411, start: Oct. 2011

Perform pre- and co-normative research for bio-based products

Call: November 2011

# Some background




Develop horizontal standards for bio-based products

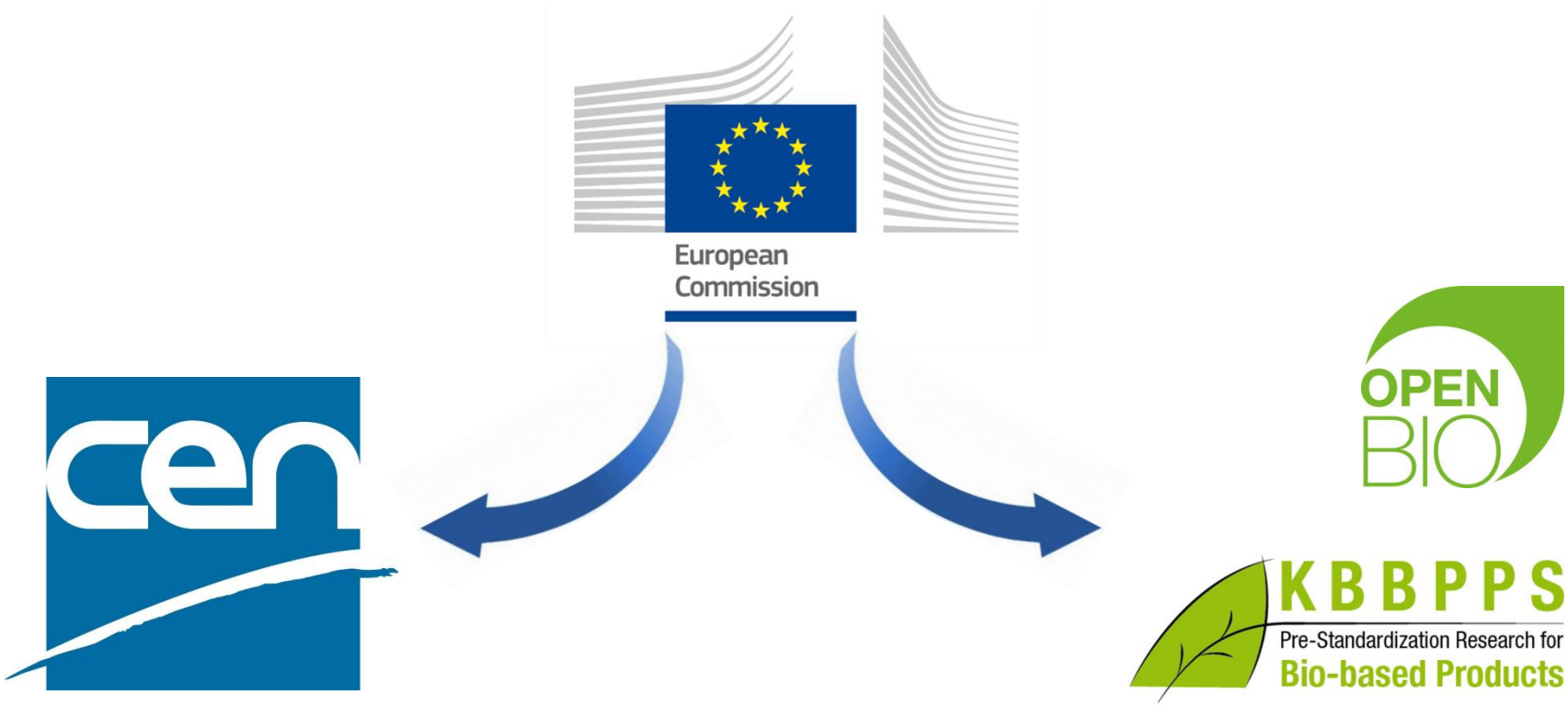
CEN/TC 411, start: Oct. 2011

Perform pre- and co-normative research for bio-based products

- **KBBPPS: 2012 – 2015**

WAGENINGEN
UNIVERSITY & RESEARCH

# Some background




Develop horizontal standards for bio-based products

CEN/TC 411, start: Oct. 2011

Perform pre- and co-normative research for bio-based products

- **KBBPPS: 2012 – 2015**
- **Open-Bio: 2013 – 2016**

WAGENINGEN
UNIVERSITY & RESEARCH

# Bio-based content

According to EN 16575: Biobased Products – Vocabulary

- **Bio-based content**

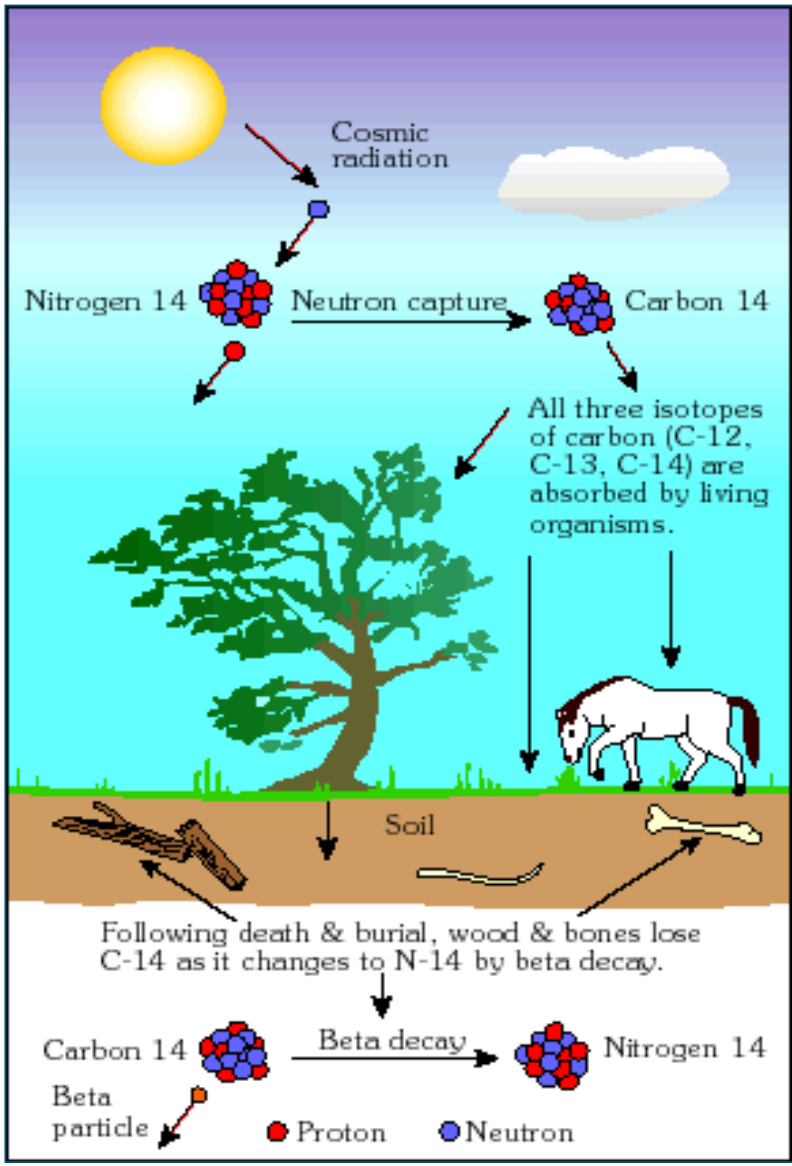
  = fraction of a product that is derived from biomass

Calculate ??

Measure ??

# Bio-based carbon determination

- Principle
  - radiocarbon dating
  - $^{14}C$ as biomarker
    - LSC - liquid scintillation counting
    - BI - beta ionisation
    - AMS – accelerated mass spectrometry
- Standard test methods
  - Materials (ASTM D6866)
  - Solid recovered fuels (EN 15440)
  - Bioplastics (EN 16137 and ISO 16620)
  - Stationary source emissions (ISO/EN 13833)
  - Bio-based products (horizontal) (EN 16440)



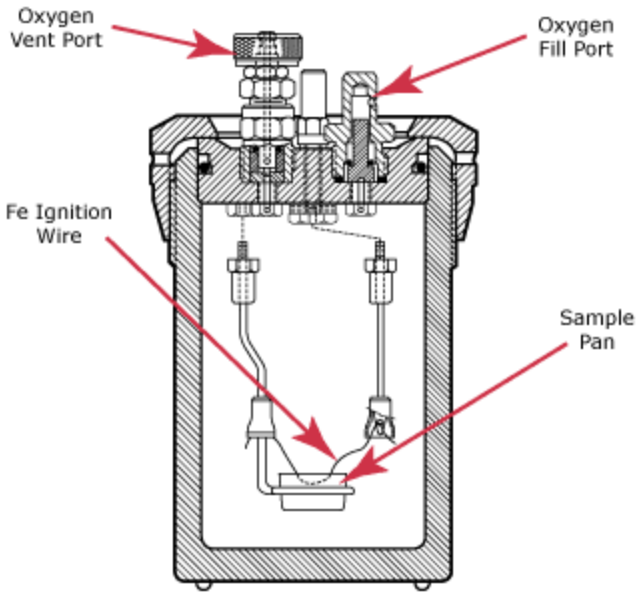

http://rses.anu.edu.au/services/radiocarbon-dating-laboratory/radiocarbon-dating-background

WAGENINGEN
UNIVERSITY & RESEARCH

# EN 16640: Radiocarbon analysis

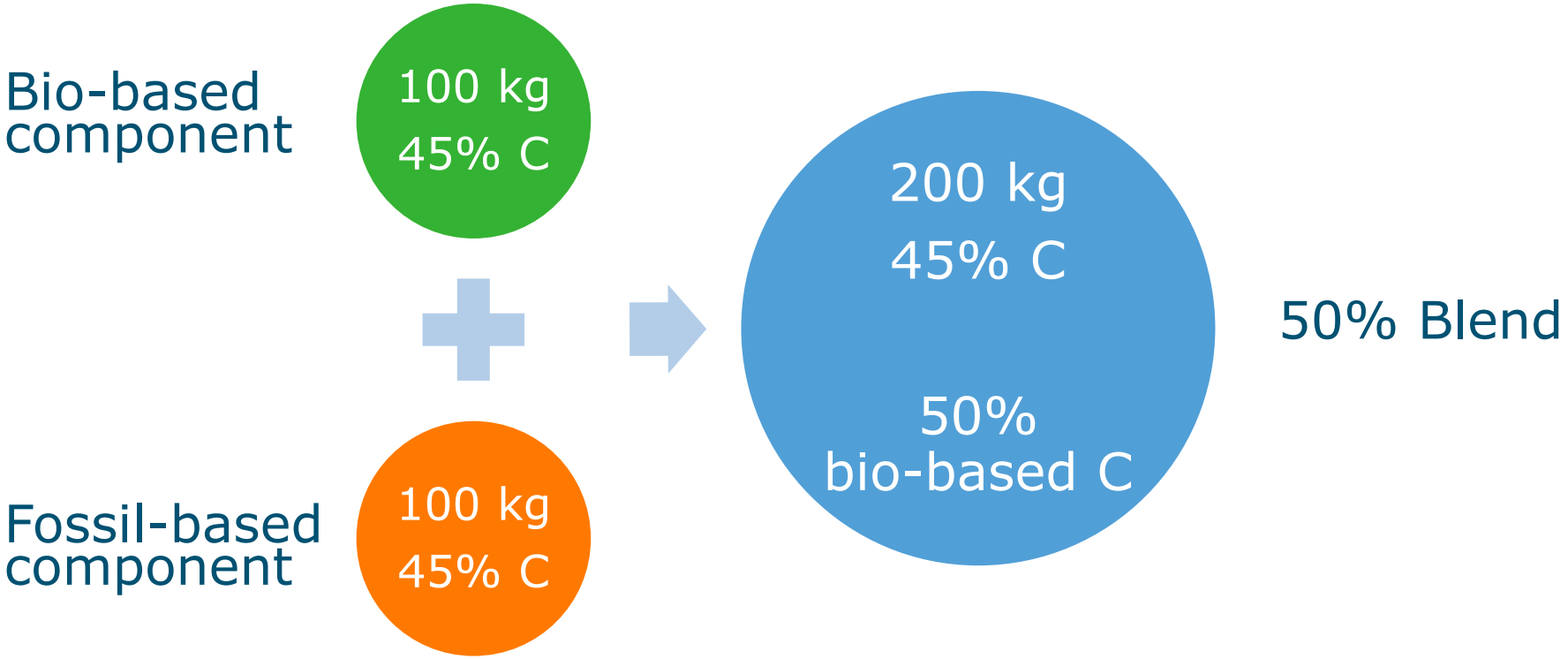
## Method for determining bio-based carbon content

- Setup of required apparatus
  - Oxygen bomb calorimeter
  - Gas collection bags
  - $CO_2$ capture
  - AMS or LSC
- KBBPPS: various samples tested
  - Paints and binders
  - Biogas
  - Flammable liquids
  - Plastic granules
  - Particle board

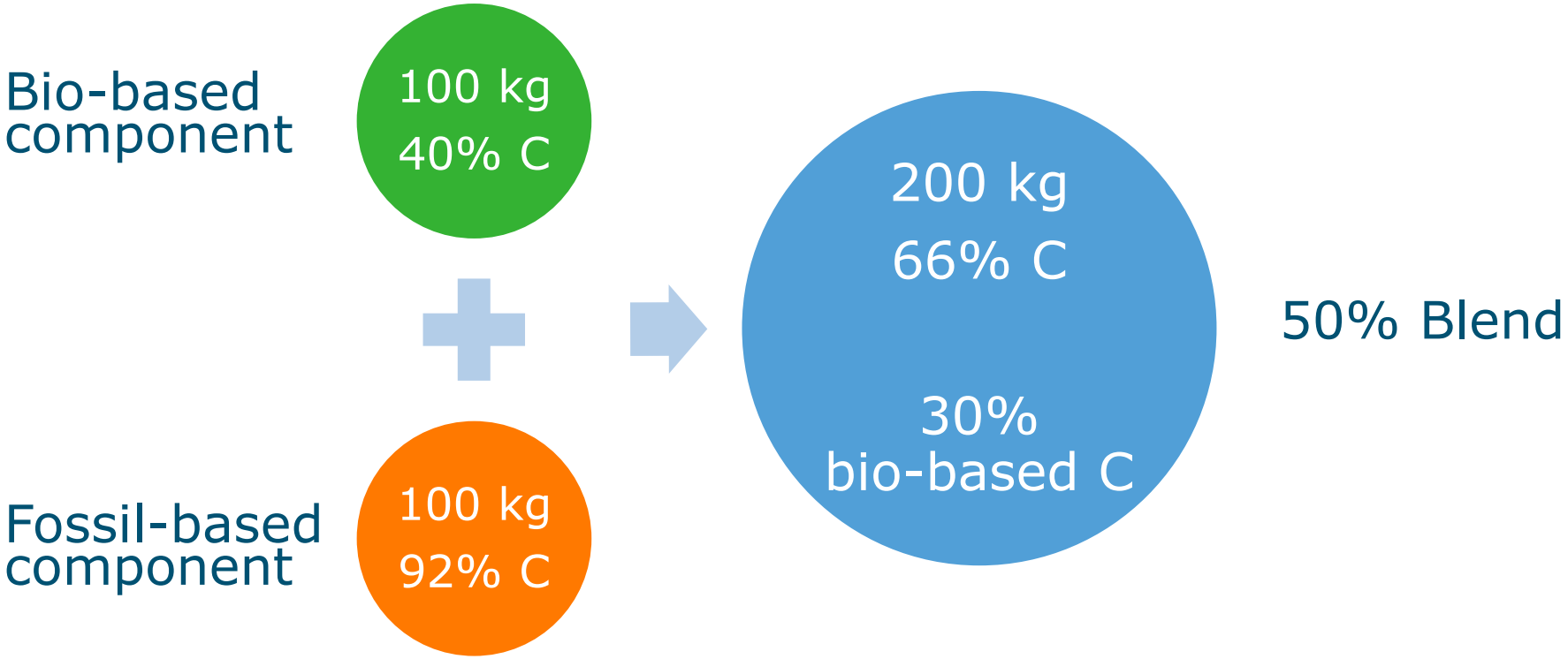



High Pressure Oxygen Combustion Bomb

# Bio-based carbon ⇔ biomass content



# Bio-based carbon ⇔ biomass content



# Bio-based carbon ⇔ biomass content

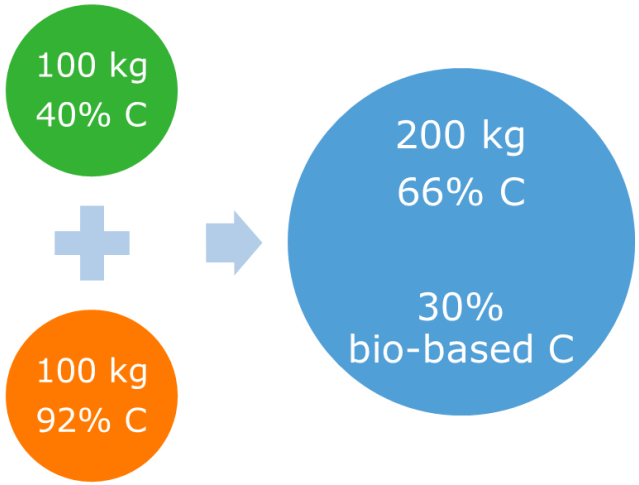
| | % bio-based carbon content | % bio-based content |
|---|---|---|
| Plastic resin (70% PE / 30% cellulose) | 18 | 30 |
| 'Plant based' PET | 20 | 31 |
| PVC (based on bioethylene) | 100 | 43 |
| Cellulose triacetate (fossil based acetic acid) | 50 | 55 |
| Coating (with biobased resin) | 76 | 15 |

# EN 16785-1: Bio-based content

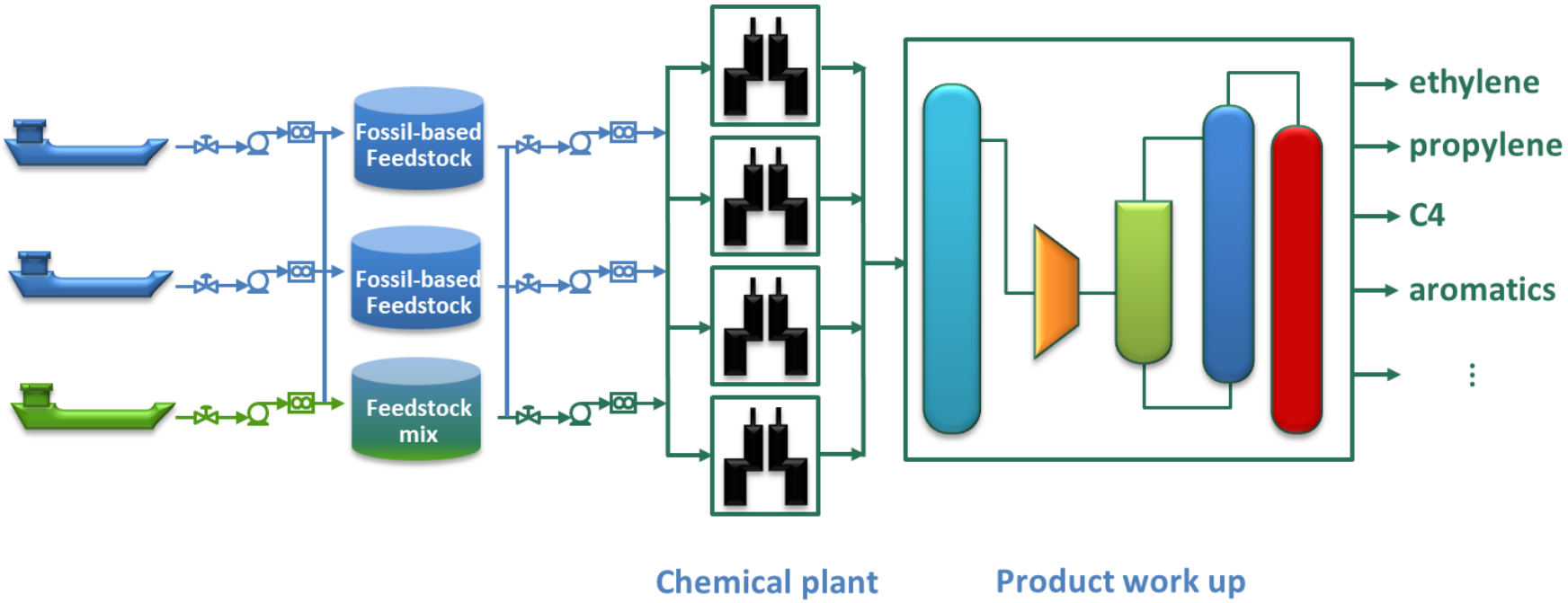
## using radiocarbon analysis and elemental analysis

- Calculation, combined with verification using:
  - $^{14}C$ content determination, and
  - elemental analysis

- Calculation using mass balance developed into separate method *(EN 16785-2)*



# Other mass balance approaches?



# Summary of standard methods

- Bio-based carbon content
  - Solid/liquid/gas materials *(ASTM D6866)*
  - Solid recovered fuels *(EN 15440)*
  - Bioplastics *(EN 16137* and *ISO 16620)*
  - Stationary source emissions *(ISO/EN 13833)*
  - Bio-based products (horizontal) *(EN 16640)*
- Bio-based content (biomass)
  - Using radiocarbon analysis and elemental analysis *(EN 16785-1)*
  - Using the mass balance method *(EN 16785-2)*

## A.3 EXAMPLE 3: Water based decorative flat paint

| | | | | | |
|---|---|---|---|---|---|
| **Method:** | EN 16785-2 | | | | |
| **Date of report** | yyyy.mm.dd | | | | |
| **Product Identification** | **Name** | Water based decorative flat paint | | | |
| | **Characteristics** | | | | |
| | Colour: | White | | | |
| | Constituents: | Biocide, dispersing agent, rheological agent, White pigment, filler, calcium carbonate, alkyd emulsion, water | | | |
| | **Product batch** | Batch no. xx.xx.xx.<br>700 t paint (dry content) | | | |
| | **Other information** | *Paints are produced by mixing raw materials in a vessel according to a precise and fixed formulation by weight. Paints are produced by individual and identified batch.* | | | |
| Mass and bio-based content of each INPUT | (per product batch) Expressed as dry matter | Raw material | Mass of raw material kg (dry) ($M_{in,i}$) | Bio-based content % [$m_{B,in,i}$] | |
| | | Biocide | 2 | 0 | |
| | | Dispersing agent | 5 | 50 | |
| | | Rheological agent | 3 | 80 | |
| | | White pigment | 150 | 0 | |
| | | Wood filler | 120 | 95 | |
| | | Calcium carbonate | 120 | 0 | |
| | | Alkyd emulsion | 300 | 94 | |
| | | Total | 700 | - | |
| Mass and bio-based content of each LOSS | (per product batch) Expressed as dry matter | Not relevant.<br>*NOTE: The loss in this process is minimal and happens after the production during packaging and does not affect the bio-based content.* | | | |
| Mass and bio-based content of the OUTPUT | (per product batch) Expressed as dry matter | Raw material | Mass of product batch kg (dry) | Bio-based content % | The bio-based content of the output kg (dry) |
| | | Biocide | 2 | 0 | 0 |
| | | Dispersing agent | 5 | 50 | 2,5 |
| | | Rheological agent | 3 | 80 | 2,4 |
| | | White pigment | 150 | 0 | 0 |



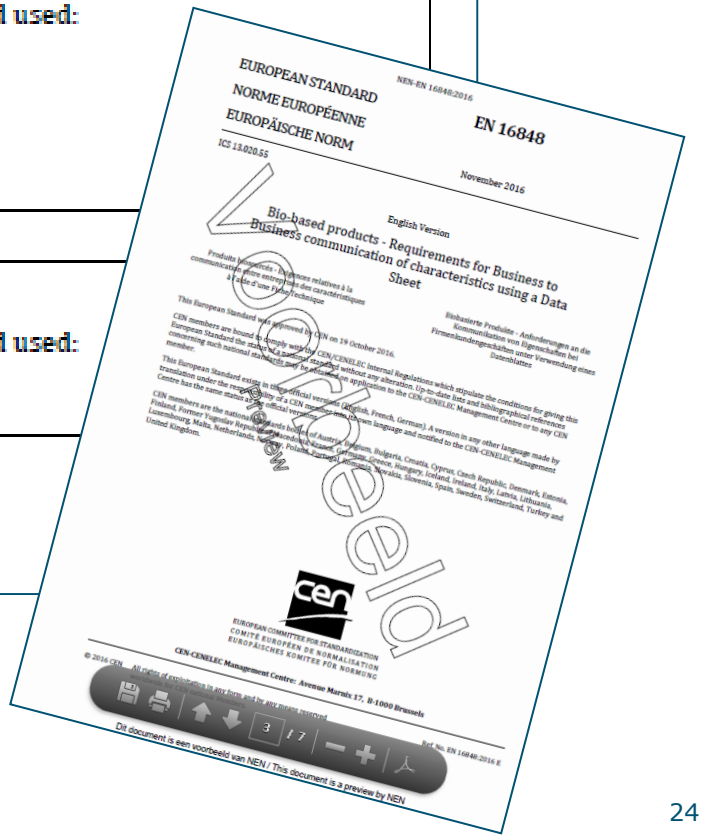
| | | | | | |
|---|---|---|---|---|---|
| | | Wood filler | 120 | 95 | 114,0 |
| | | Calcium carbonate | 120 | 0 | 0 |
| | | Alkyd emulsion | 300 | 94 | 282,0 |
| | | Total | 700 ($M_{t,out}$) | - | 400,9 ($m_{B,out}$) |
| **Bio-based content** | (per product batch) Expressed as a percentage of dry matter | $m_B = 100 \times \frac{M_{B,out}}{M_{t,out}} = 100 \times \frac{\sum M_{in,i} \times m_{B,in,i} - \sum M_{lo,j} \times m_{B,lo,j}}{\sum M_{in,i} - \sum M_{lo,j}}$<br>$m_B = 100 \cdot \frac{400,9}{700} = 57,3\%$<br>Bio-based content: 57 %. | | | |

# EN 16848: Bio-based products

## Requirements for B2B communication of characteristics

| | |
|---|---|
| **BIO-BASED CARBON CONTENT** | |
| **Minimum verifiable bio-based carbon in relation to the total carbon (%)**<br>**The standard used for measuring or calculation shall be stated.**<br>**The reference method to determine the bio-based carbon content shall be CEN/TS 16640 in case of discrepancies.** | %<br>Standard used: |
| **BIO-BASED CONTENT** | |
| **Minimum verifiable biomass in relation to the total mass of the product (%)**<br>**The bio-based content shall be determined according to EN 16785-1:2015 or prEN 16785-2:2015.** | %<br>Standard used: |

**12**



# Certification of bio-based content

- USDA Biopreferred program
  - Based on ASTM D6866
  - Expressed as % of total organic carbon
- Vinçotte OK Biobased
  - 1-4 stars (20-40%, 40-60%, 60-80%, >80%)
  - Expressed as % of total organic carbon
- DIN CERTCO DIN geprüft BIOBASED
  - 3 levels (20-50%, 50-85%, >85%)
  - Expressed as % of total carbon
- NEN/ACDV bio-based content
  - Planned to be launched in November 2016
  - Based on EN 16785-1





WAGENINGEN
UNIVERSITY & RESEARCH

# Summary

- Bio-based = derived from biomass
- Bio-based content can be determined with various methods
- Bio-based carbon content ≠ biomass content
- Various certification schemes for bio-based products
- Communication is crucial !!

# Thank you!

Contact:

maarten.vanderzee@wur.nl

WAGENINGEN
UNIVERSITY & RESEARCH