22nd Baltic Peat Producers Forum

PEAT'S CARBON LIFE-CYCLE

FIRST RESULTS

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LAND USE, LAND USE CHANGE AND FORESTRY (LULUCF) TIER 1

EQUATION 7.5
OFF-SITE CO_2–C EMISSIONS FROM MANAGED PEATLANDS (TIER 1)

$$CO_2\text{–}C_{WW_{peat_{off-site}}} = \frac{(Wt_{dry\_peat} \bullet Cfraction_{wt\_peat})}{1000}$$

or

$$CO_2\text{–}C_{WW_{peat_{off-site}}} = \frac{(Vol_{dry\_peat} \bullet Cfraction_{vol\_peat})}{1000}$$

Default IPCC Cfraction 0.4 (NR) – 0.45 (NP) t C/t peat; 0.07 NP – 0.24 NR t C/m^3 peat

Where:

$CO_2\text{–}C_{WW\ peat\ off\text{-}site}$ = off-site CO_2–C emissions from peat removed for horticultural use, Gg C yr^{-1}

Wt_{dry_peat} = air-dry weight of extracted peat, tonnes yr^{-1}

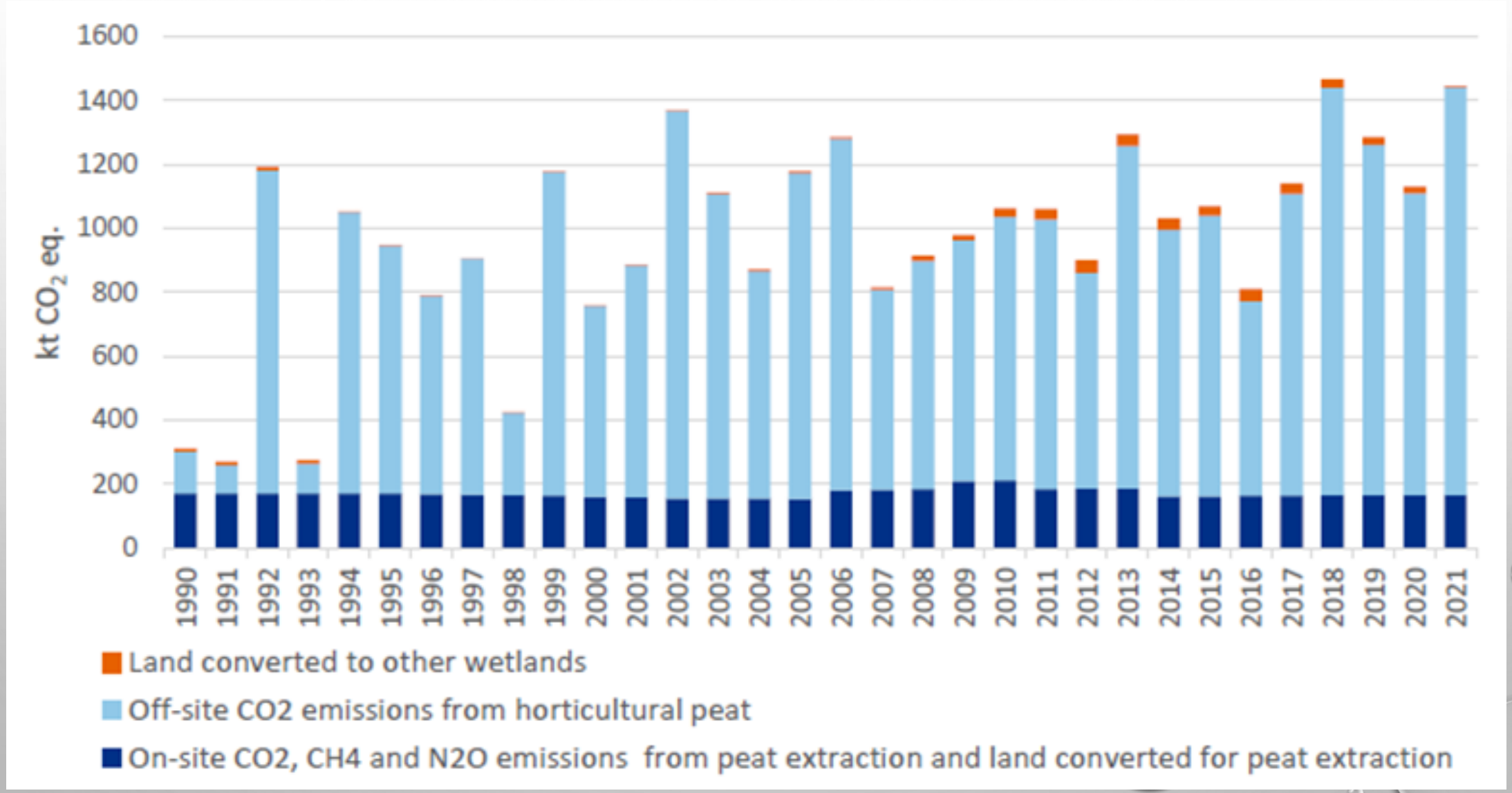
Vol_{dry_peat} = volume of air-dry peat extracted, m^3 yr^{-1}

$Cfraction_{wt\_peat}$ = carbon fraction of air-dry peat by weight, tonnes C (tonne of air-dry peat)$^{-1}$

$Cfraction_{vol\_peat}$ = carbon fraction of air-dry peat by volume, tonnes C (m^3 of air-dry peat)$^{-1}$

IPCC Guidelines for National Greenhouse Gas Inventories. Chapter 7: Wetlands

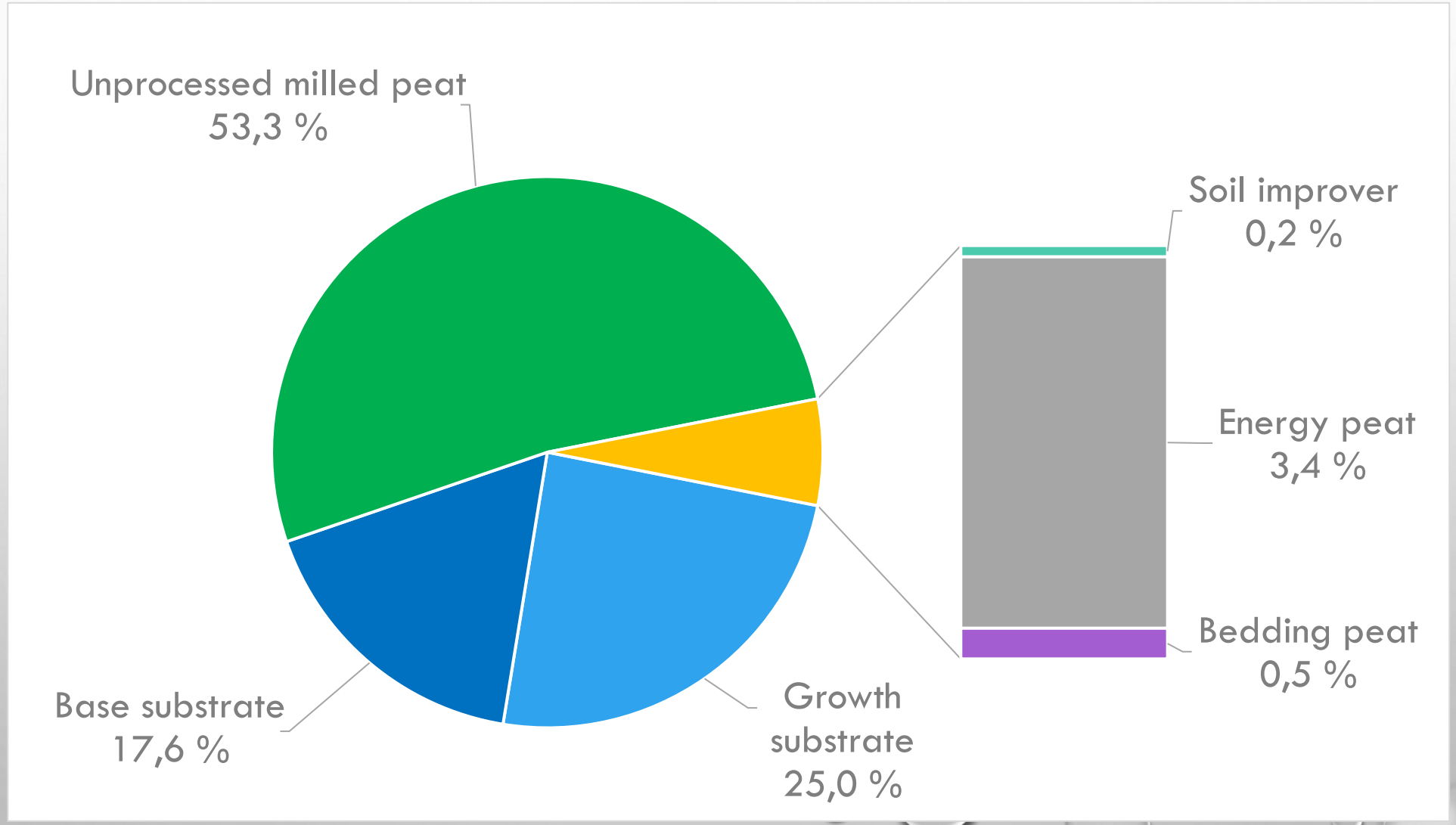
ESTONIAN ON- AND OFF-SITE EMISSIONS OF USING HORTICULTURAL PEAT



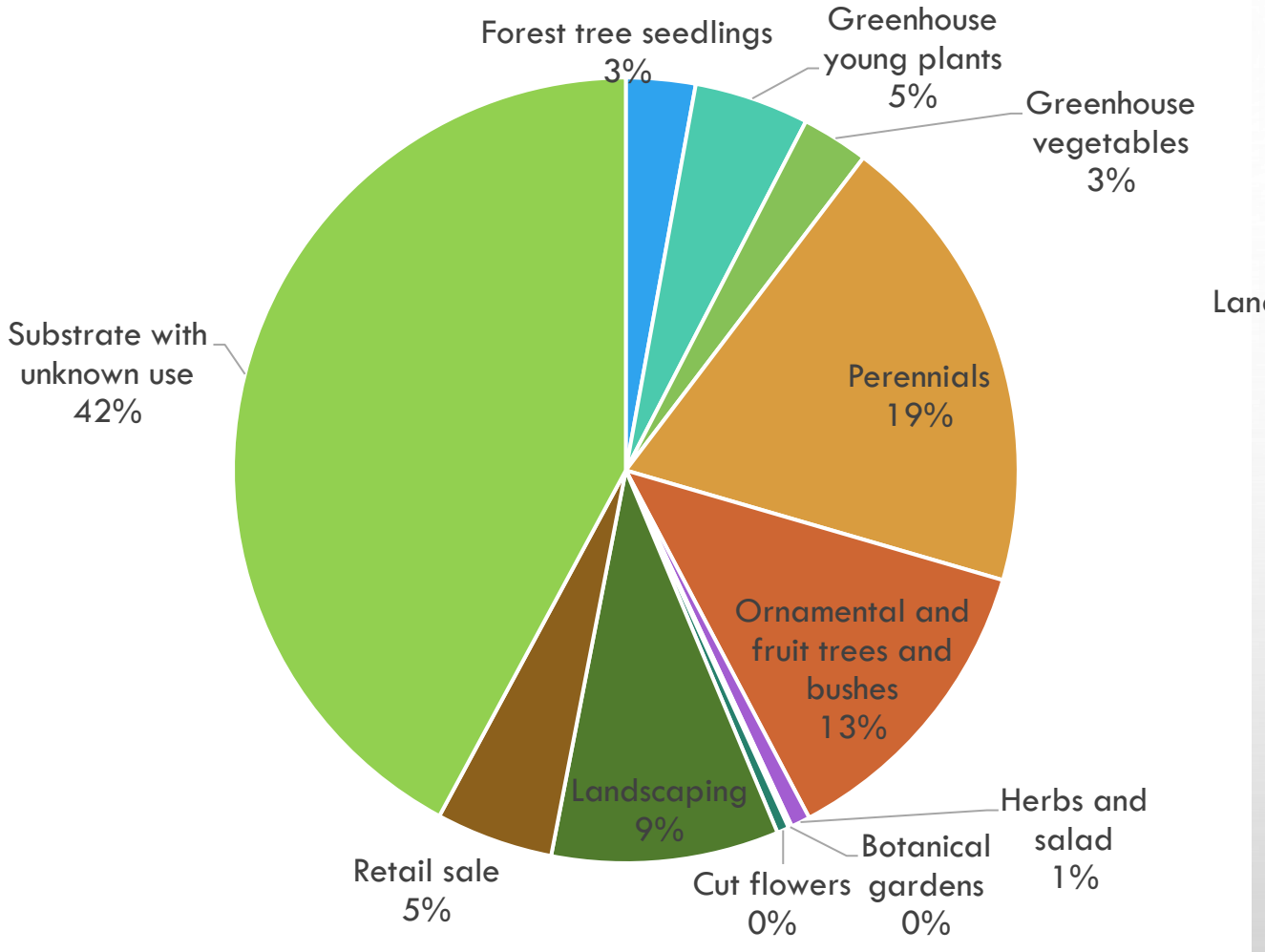
STUDY MOTIVATION AND AIMS

- BALTIC COUNTRIES PROVIDE ANNUALLY 2.5 – 3 MILLION TONS OF PEAT FOR GROWING MEDIA
- OFF-SITE CARBON EMISSION IS HEAVY BURDEN TO ALL PEAT MINING COUNTRIES WHILE DEMAND FOR GROWING MEDIUM IS INCREASING
- CURRENT UNDERSTANDING AND REPORTING OF PEAT SUBSTRATE RELATED CARBON CYCLE IS LIMITED
- *WE ACKNOWLEDGE CEO OF ESTONIAN PEAT ASSOCIATION ERKI NIITLAAN AND MARTIN KÜTTIM FROM TALLINN UNIVERSITY WHO INITIATED CONSULTATIONS AND THE PROJECT TO STUDY POSSIBILITIES FOR CIRCULAR ECONOMY IN PEAT INDUSTRY*

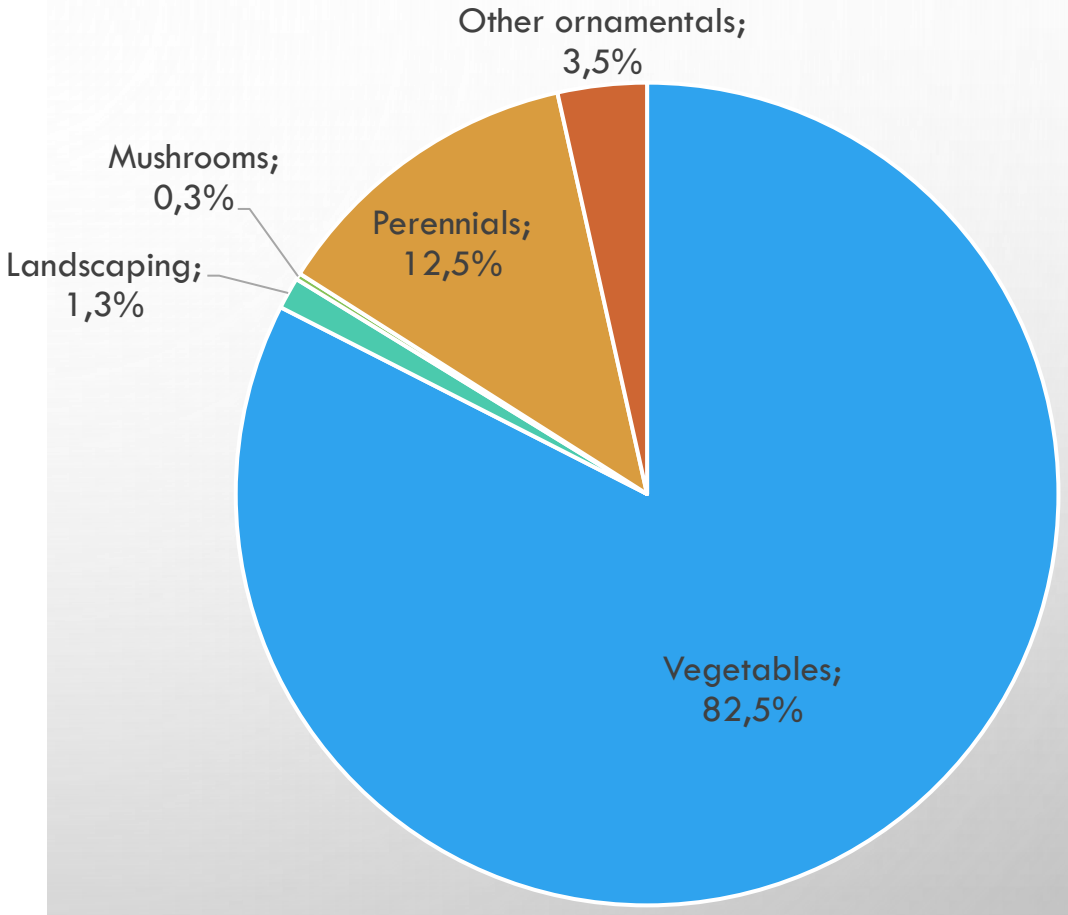
SALE OF PEAT EXTRACTED IN ESTONIA 2022



USE OF PEAT EXTRACTED IN ESTONIA 2022



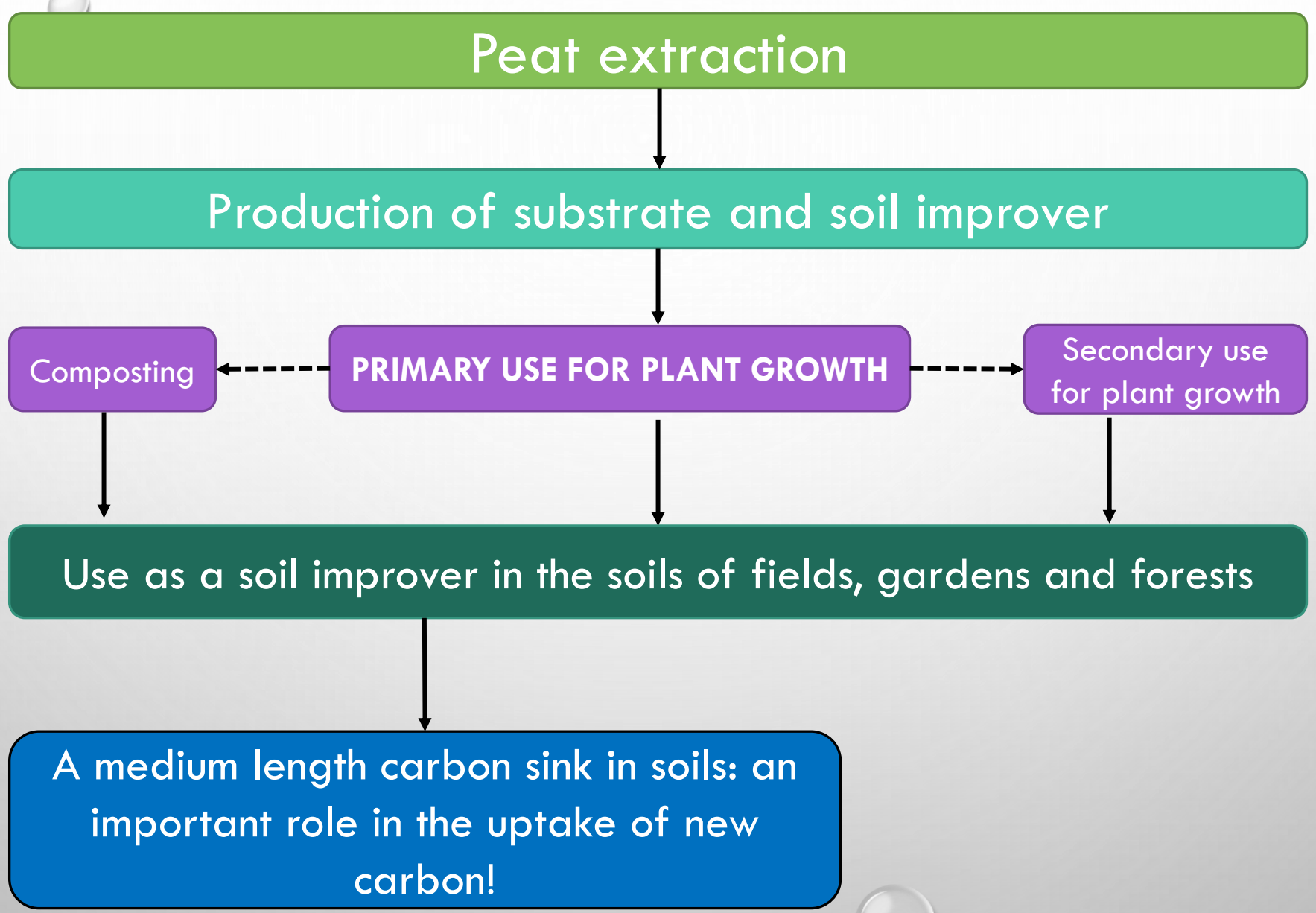
In Estonia

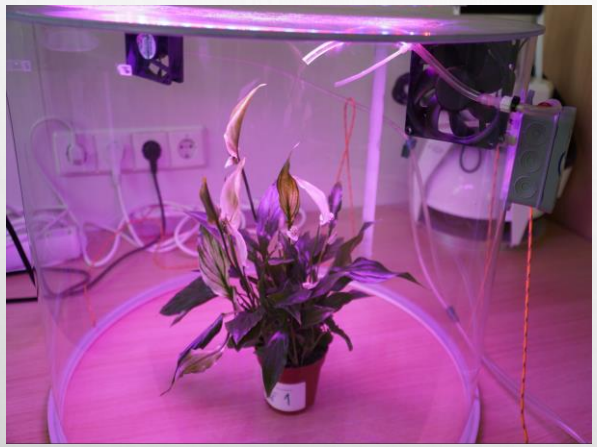


At export markets

MAIN EXPORT MARKETS FOR ESTONIAN PEAT

		1000 tons	M €
1	The Netherlands	413	23,2
2	China	163	31,7
3	Germany	131	6,1
4	Spain	97	13,7
5	France	86	7,5
6	Belgium	78	4,4
7	Latvia	43	4,2
8	Poland	27	3,5
9	Turkey	26	4,2
10	Marocco	17	2,3


Peat extraction
Production of substrate and soil improver
Composting
PRIMARY USE FOR PLANT GROWTH
Secondary use for plant growth
Use as a soil improver in the soils of fields, gardens and forests
A medium length carbon sink in soils: an important role in the uptake of new carbon!



ORNAMENTAL PLANTS
CONTAINER, INDOOR

- Substrate C-loss 1.2 - 5.7% per year
- Substrate and biomass is handled as organic waste and composted
- C-loss during composting is 18-22%
- C TO SOIL = ((SUBSTRATE)-(SUBSTRATE LOSS)+ABOVE GROUND BIOMASS + BELOWGROUND BIOMASS)*0.8

VEGETABLES

CONTAINERS

- 2 pathways:
  - a) primary use + composting (e.g. salads)
  - b) primary use with growing seedlings and planting to te soil + biomass residuals

- <u>Broccoli and cauliflower:</u> 30 000 – 40 000 plants per hectare * 7.9 g C in substrate = **0.237 – 0.316 t C per hectare to field soil**

<u>3 substrates:</u>

C-content

42.0% (±1.41)

47.8% (±0.50)

48.4% (±0.55)

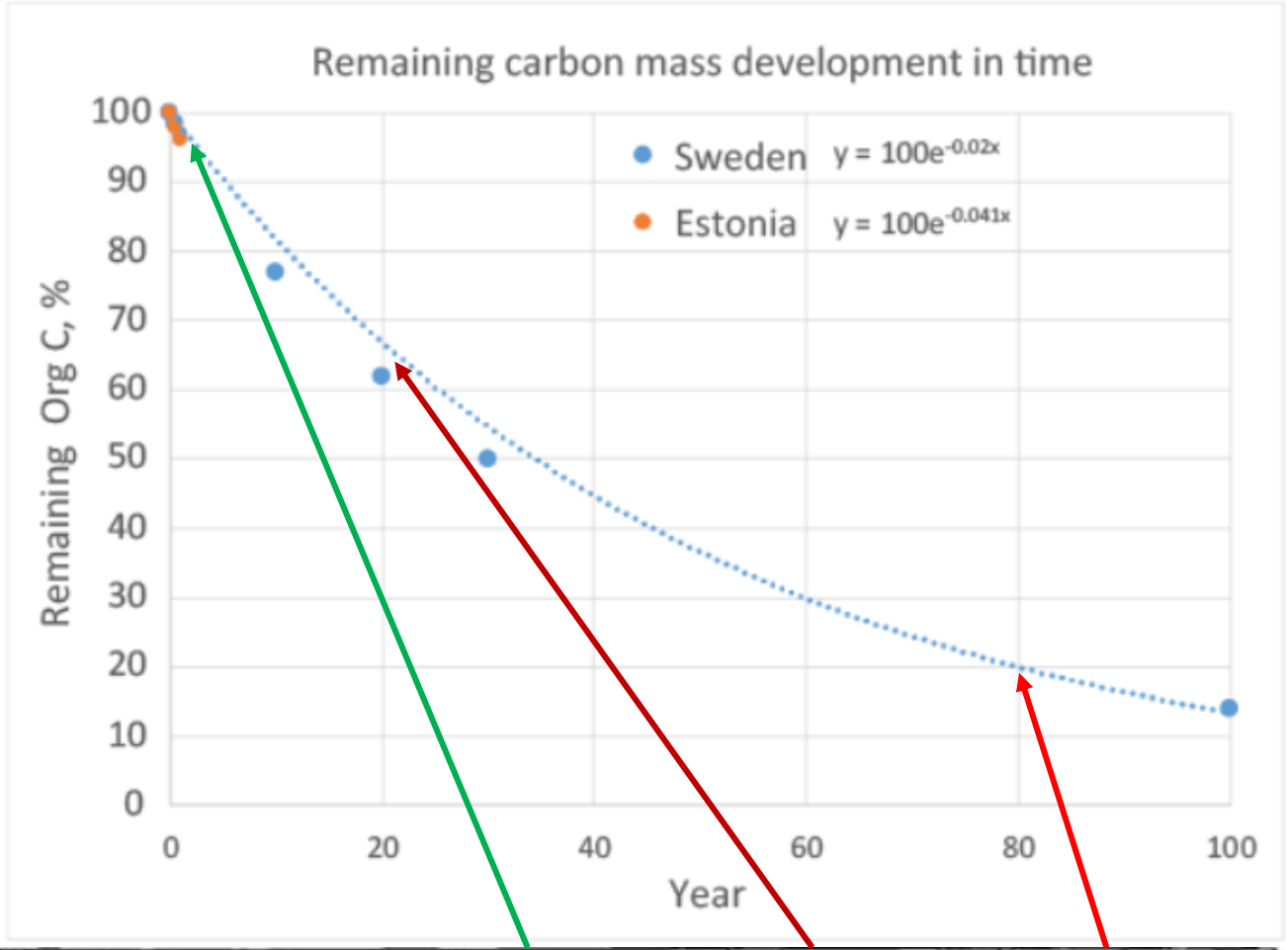
- <u>Salads</u>: 62 500 – 120 000 plants per hectare * 3.2 g C substrate = **0.2 – 0.384 t C per hectare to field soil**

(FORESTRY) TREE NURSERY

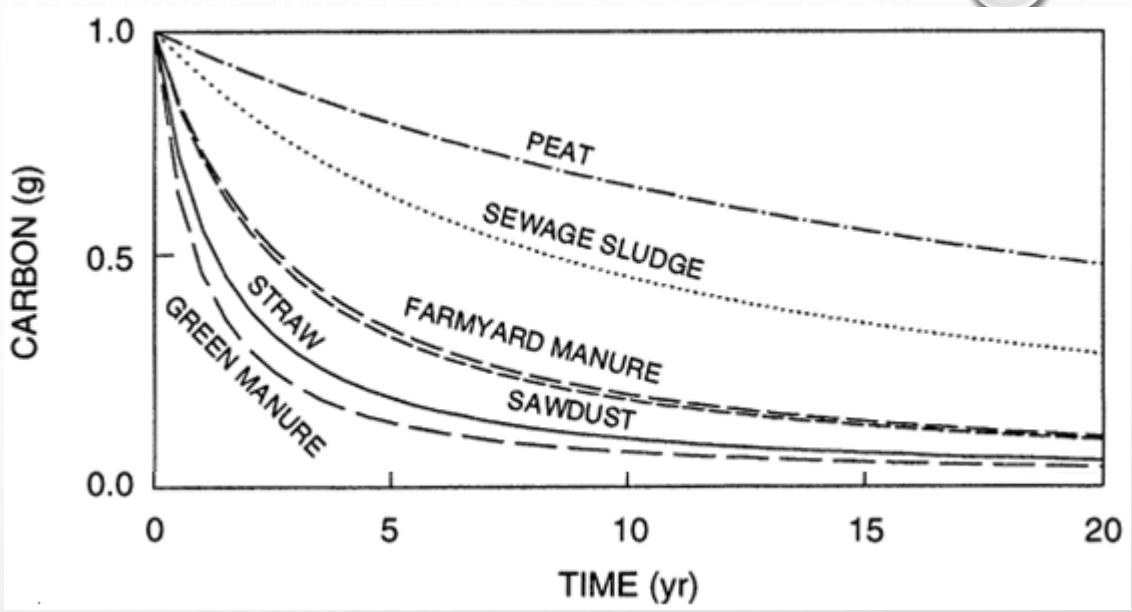
OPEN ROOT AND CONTAINER PLANTS

- 2 pathways:
  - a) open root plants
  - b) container plants
- Used substrate (after 2-3 yeat usage) is used as soil improver, usually 3-5 t/ha (wet weight)
- Container plants planted directly to the soil – container plants are preferred in case of organic soils (to mitigate frost heaving risk) and dry/sandy soils (improves soil moisture)
- Forest seedles: 2200 – 3200 plants per hectare * 9.5 g C in substrate = **0.02 – 0.03 t C per hectare to forest soil**

CARBON LOSS IN SUBSTRATE



Organic material	H 1 to H 2	H 5 to H 6	H 9 to H 10
Cellulose (%)	15-20	5-15	-
Hemicellulose (%)	15-30	10-25	0-1
Lignin (%)	5-40	5-30	5-20
Humic acids (%)	0-5	20-30	50-60

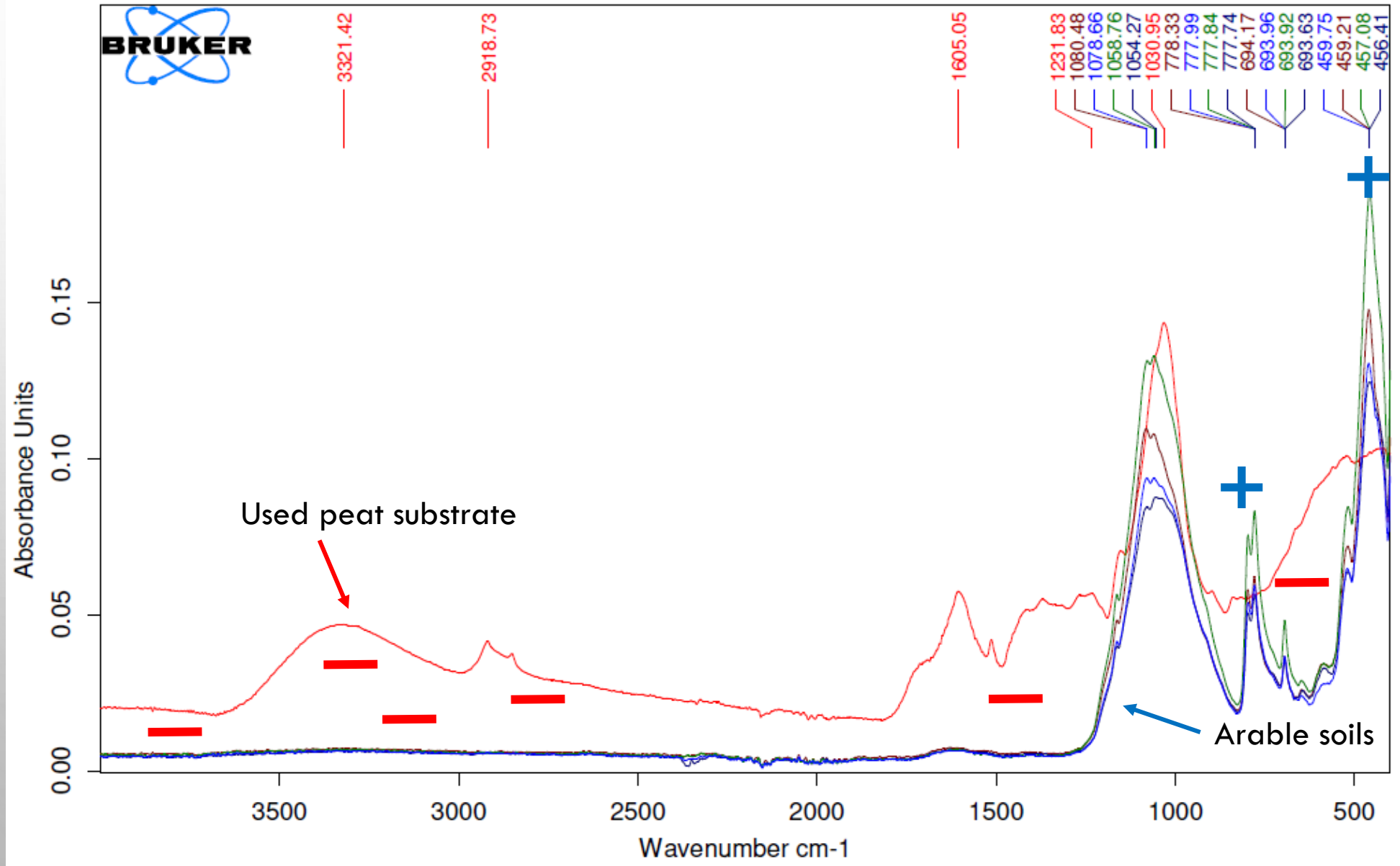


Predicted remaining carbon mass following a single addition of organic matter in the long-term field experiment (Hyvonen et al., 1996)

Compost, staw, wood fiber are near C-neutral but mixing them with peat will lead higher short-term CO_2 emissions!

Fuchsman CH. Peat. Industrial Chemistry and Technology. Oxford, UK: Academic Press/Elsevier 1980

PEAT TO SOIL


BRUKER
3321.42
2918.73
1605.05
1231.83
1080.48
1078.66
1058.76
1054.27
1030.95
778.33
777.99
777.84
777.74
694.17
693.96
693.92
693.63
459.75
459.21
457.08
456.41
Absorbance Units
0.00
0.05
0.10
0.15
3500
3000
2500
2000
1500
1000
500
Wavenumber cm-1
Used peat substrate
Arable soils

TIER 2

	von Post	**Lignin, %**	Hemicellulose, %	Cellulose, %	**org C, %**
Site 1	H5	**39.9**	16.9	15.8	**46.6**
Site 2	H5	**55.9**	6.7	9.3	**47.8**
Site 3	H4	**55.1**	6.6	10.4	**48.3**
Site 4	H6	**68.6**	0.6	1.9	**47.5**
Site 5	H6	**44.2**	2.6	25	**47.5**
Site 6	H5	**44.5**	2	22.1	**47.8**
Site 7	H6	**68.2**	3.8	4	**47.4**
Site 8	H6	**55.1**	19.3	2.2	**45.4**
Site 9	H4	**52.9**	8.8	13.1	**46.3**
Site 10	H7	**65**	5.5	2.8	**49**
Site 11	H6	**51**	21.7	5.2	**48.5**
Site 12	H4	**40.2**	15.3	15.8	**46.2**
Site 13	H5	**41.9**	4	27.7	**48.9**
Site 14	H6	**60.9**	11.9	2.3	**46.2**
Average		**53.1**	8.9	11.3	**47.4**

- Actual national values for peat C content
- Exclusion of substrate which is planted/spreaded to peat soils
- Accounting for average C remaining in soil as substrate after-use
- Substrate lignin content is important if Tier 3 is aimed…

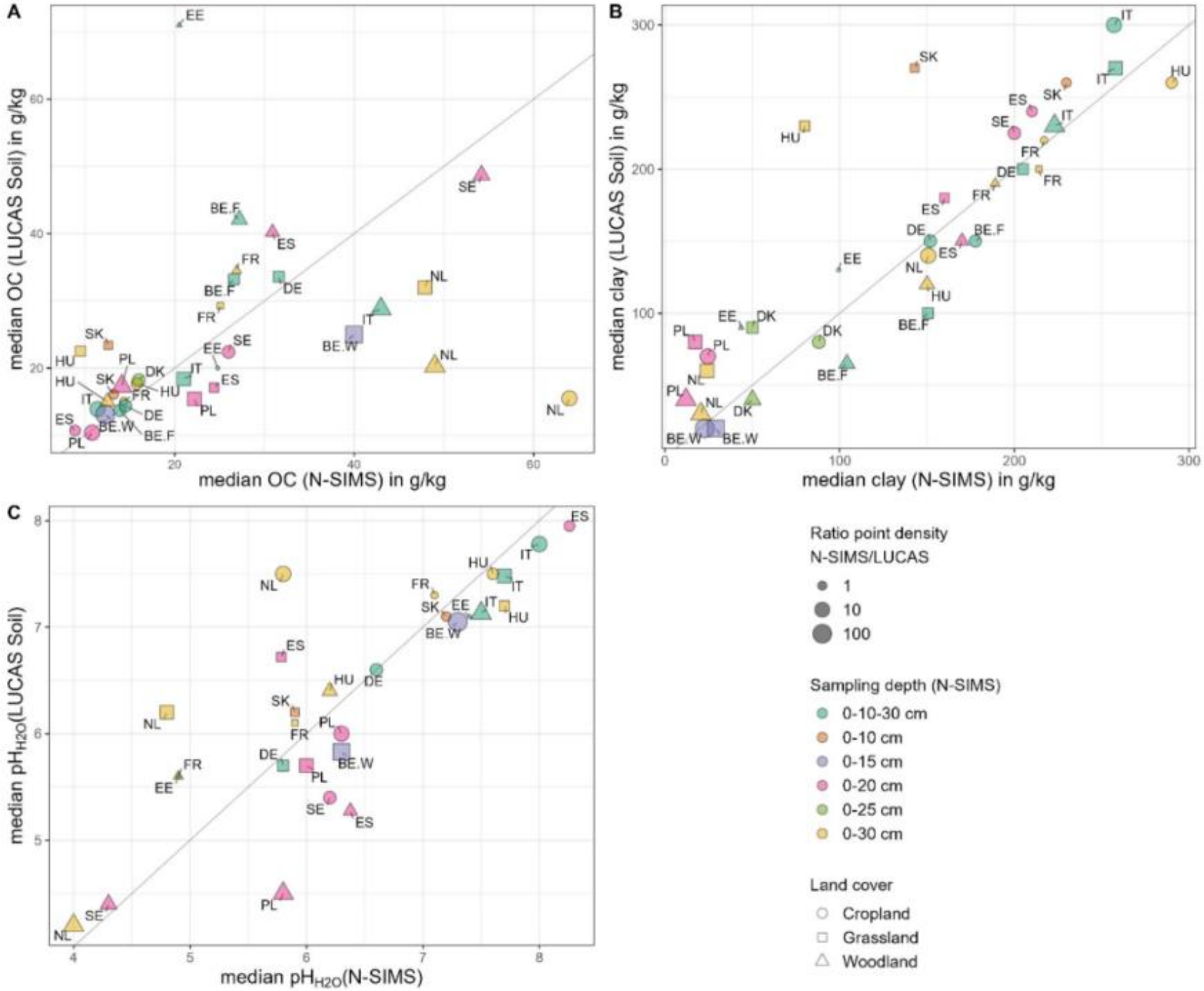
TIER 3

- Know your customer: where and how substrate is used?
- what is soil clay and org C content?
  model local/regional soil org C change

- Use local peat chemical properties to model remaining carbon mass

- Exclude double-counting: area-based CO_2 emissions in agricultural and forestry sector include peat emissions that are already accounted as peat industry off-site emissions

- RothC model calculation by Estonian University of Life Sciences shows that at least 15,7% and up to 27-30% of peat C may stay as stable carbon in soil.



Froger et al., 2024
https://doi.org/10.1016/j.geoderma.2024.117027