



Biochar commercialization and legislation in the EU

Improvement of comprehensive bio-waste transformation and nutrient recovery treatment processes for production of combined natural products

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FP7 REFERTIL (289785)

www.refertil.info



EUROPEAN UNION
EUROPEAN REGIONAL
DEVELOPMENT FUND

**E2BEBIS – Environmental and Economical Benefits from Biochar
Clusters In the Central Area
Prague, 14-15 November, 2013**



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Generation of animal and vegetal waste (EWC-Stat 09)

- EWC-Stat 09.1: Animal and mixed food waste
- EWC-Stat 09.2 : Vegetal waste
- EWC-Stat 09.3: Slurry and manure

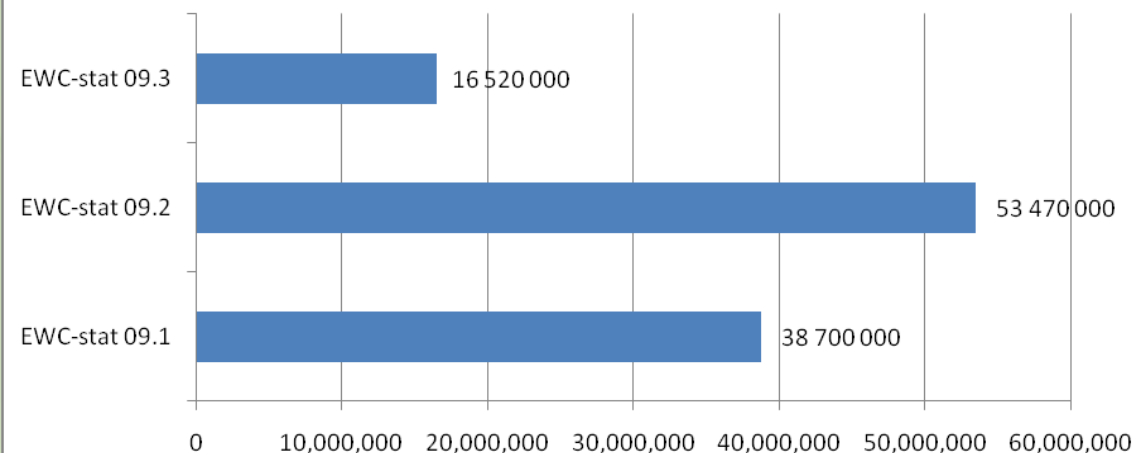
More than 40 million tonnes of animals (bovine, poultries and pigs) slaughtered in the EU 27 countries in 2008.

50% / 20M t/y → rendering industry

From which minimum 2-3 M t/y → high P animal bone

Animal bone is economical important high volume industrial accomodity and renewable resource with high P concentrated apatite mineral content.

EWC-Stat 09 Animal and vegetal waste generation in 2010 (Tonnes)



GEO	TOTAL Slaughtered 1000 t (2008)
EU 27	41,776
Denmark	2,012
Germany	7,516
Ireland	857
Spain	5,518
France	5,501
Italy	3,781
Hungary	881
Netherlands	2,435
Poland	3,456
Slovenia	127
Sweden	309
United Kingdom	1,247

COMMENTS TO EU WASTE STATISTICS

- In contrast with other waste streams which are documented by public authorities, **this is not the case for several organic waste streams** such as green waste and manure.
- The share of waste from agriculture, forestry and fishery (NACE section A) is low in the Eurostat database because the **considerable amounts of manure and slurry are not counted as waste when they are reused in agriculture** as fertiliser or soil improver.
- In line with the 2008/98/EC **the reused manure is not listed as waste** and out of scope of national and European waste statistics.
- **The real amounts of all the generated manure are much higher both in MS and EU27 level that currently listed in Eurostat under EWC-Stat 09.3.**



BACKGROUND: The Global Phosphorus situation

THE VULNERABILITY OF EU P-SUPPLY → THE AGRICULTURE and FOOD SECTORS ARE AT RISK

- Limited domestic P-reserves → almost entirely **dependent on P-rock imports**.
- Rising Global P-rock demand → **higher prices and mounting competition**.
- **The security of P rock supply is under increasing pressure.**

POLITICAL & ECONOMICAL RISK

- Main P-rock producers: **China , USA and Morocco**.
- USA & China consume almost all domestic production.
- China apply 135% export tariff !
- **Morocco: chief exporter**
- Stable supply from Tunisia, Jordan and Syria is no longer guaranteed (political instability). **GAFSA production decreased to 30% of its total capacity in 2011!**

TECHNICAL - Cadmium and Uranium are high risk Prock contaminants

Excessive fresh-water consumption by P-industry:

- **Approx. 3 m³ / ton of phosphate concentrate.**
- Compete with agriculture and drinking water
- **WATER SHORTAGES in Western Sahara**

Phosphate rock is an increasingly scarce resource



WHAT IS BIOCHAR?

Biochar is plant and/or animal waste biomass origin carboniferous material from Authority permitted industrial production operations with permitted applications in open ecological soil environment. Biochar is aiming carbon negative multi functional and eco-safe soil enhancement.



BIOCHAR APPLICATION DOSES:

Bone char: natural NPK fertilizer, PGP, biocontrol, water retention, carbon sequestration.

200 kg/ha – 1000 kg/ha

Plant based biochar: water retention, carbon sequestration.

5,000 kg/ha – 20,000 kg/ha



WHAT IS NOT BIOCHAR? – I.

- Biochar is **NOT a fine ground charcoal**, and/or
- biochar is **NOT labile carbon** material that application is rapidly promoting GHG developments, and/or
- biochar is not carbon material that does **NOT meet quality** to be put into open ecological soil environment (**IRREVOCABLE ACTION**), and/or
- made from input feed material, that is originating from **primer and secondary land use products**, and/or the feed material use is competing with human and/or animal food supply and/or food crop plant production nutrient supply, and/or
- made from input **feed material that is not from living, or recently living organisms** and containing any ecotox substances (IMPORTANT: when biochar is used in dose 10 t/ha, than the concentration limits of the possible exotox substances are 10x multiplied VS when dose is 1 t/ha only) and/or
- the **pyrolysis process is not towards zero emission performance**, and/or

Biochar is **NOT a fine ground charcoal**



WHAT IS **NOT** BIOCHAR? – II.

- the pyrolysis process is **not energy self sustaining**, and/or
- the pyrolysis – **biochar production - process is not Government Authority permitted** and controlled operation, and/or
- the **biochar material open ecological soil environment industrial scale application is not Government Authority permitted** and controlled operation, and/or
- the overall life cycle of the process (input material, process, biochar use) is **having more negative environmental impact than total benefit**, and/or
- the biochar product having **no labelled producers responsibility performance**, and/or
- the **output biochar product economical value and free market valorization is not based on common market demands** and commercialization process, e.g. biochar economical valorization may not be based grants, subsidies, and/or unclear carbon trade programmes.



Biochar is **NOT** a labile carbon

REFERTIL FOCUS

- **TRANSFORMATION OF THE EU ORGANIC BIO-WASTE STREAMS** into safe biochar and compost products. WfD/EoW core element.
- **REDUCING THE DEPENDENCE ON MINED AND NON RENEWABLE PHOSPHORUS AND ENERGY-INTENSIVE NITROGEN SUPPLY** resources,
- **CONTRIBUTING TO THE INTERNATIONAL STANDARDIZATION OF COMPOST/ BIOCHAR** technology and products, incl BC made from 22 EWC main categories.
- Providing strong **POLICY SUPPORT TO THE EUROPEAN COMMISSION DG Industry and Enterprise + other DG's** for regulation of compost and biochar products under the **NEW FERTILIZER REGULATION** revision and **EU 28 law harmonization**.



PLANT RESEARCH INTERNATIONAL

WAGENINGEN UR



KNOWLEDGE CENTRE FOR AGRICULTURE



Biomasa del Guadalquivir



FP7 REFERTIL (289785) - CONSORTIUM



THE REFERTIL FP7 BIOCHAR & COMPOST CONSORTIUM



- **14 partners from 10 EU countries**
- **7-30 years** active BC S&T involvement background.
- **Work field:** from BC applied science into BC industrial scale up & commercialization
- **Bringing together:**
 - Experts,
 - Researchers
 - SMEs industrial partners from a variety of sectors
 - All stakeholders.



THE REFERTIL FP7 KEY BIOCHAR PARTNERS

TERRA HUMANA (Edward Someus): Coordinator and BC key S&T development, design and engineering

Dr. WESSLING Lab: Central accredited biochar laboratory

- Biochar QTY and safety assessment.
- Development of accredited BC analytical methods.
- **Biochar accreditation in early 2014.**

VFL: Biochar economy + field trials

Agroinnova: Biochar field trial tests since 2005.

WUR/DLO/ TERRA / University of Hannover: Microbiological improvement of biochar since 2005.

Aarhus University: Evaluation of effects of biochar application to soil.

Participant organization	Country	Activity
TERRA HUMANA - Coordinator & biochar key tech RTD + designer	HU	Company
Plant Research International, Wageningen	NL	RES
Aarhus University	DK	University
The Knowledge Centre for Agriculture - VFL	DK	Advisory Centre
University of Torino, Agroinnova	Italy	University
Gottfried Wilhelm Leibniz Universitaet Hannover	DE	University
Biomasa del Guadalquivir S.A.	E	SME
TWI Ltd.	UK	RES
WESSLING Lab Hungary Kft.	HU	Company
KOTO d.o.o.	SLO	SME
Comune di Grugliasco	Italy	City Council
Renetech Bioresources Ltd.	IRL	SME
Profikomp Zrt	HU	SME

Wide range of Partners from different BC S&T sectors



ACCREDITED QUALITY AND SAFETY ASSESSMENT

- **PRODUCT/NUTRIENT QUALITY EVALUATION.**
- **PRODUCT SAFETY EVALUATION:** determination of the potential key contaminants (heavy metals, organics,..) having negative effects on the human, plant and the environment.
- **ACCREDITED ANALYSIS IN WESSLING LABORATORY**
 - ✓ 57 biowaste / byproducts from 9 EU countries,
 - ✓ 31 different biochar products, 120 samples from 7 EU countries
 - ✓ 39 compost samples from 6 EU countries
 - ✓ 13 soil samples
- **AVAILABLE BIOCHAR TECHNOLOGY EVALUATIONS**
 - ✓ Comprehensive overview of the BC tech market.
 - ✓ **7 BC technologies contracted for detailed evaluations**
 - ✓ **Only 2 found sustainable by independent evaluator**
 - ✓ Plant based BC small/medium solution: PYREG
 - ✓ ABC Animal Bone bioChar medium/large industrial solution: 3R



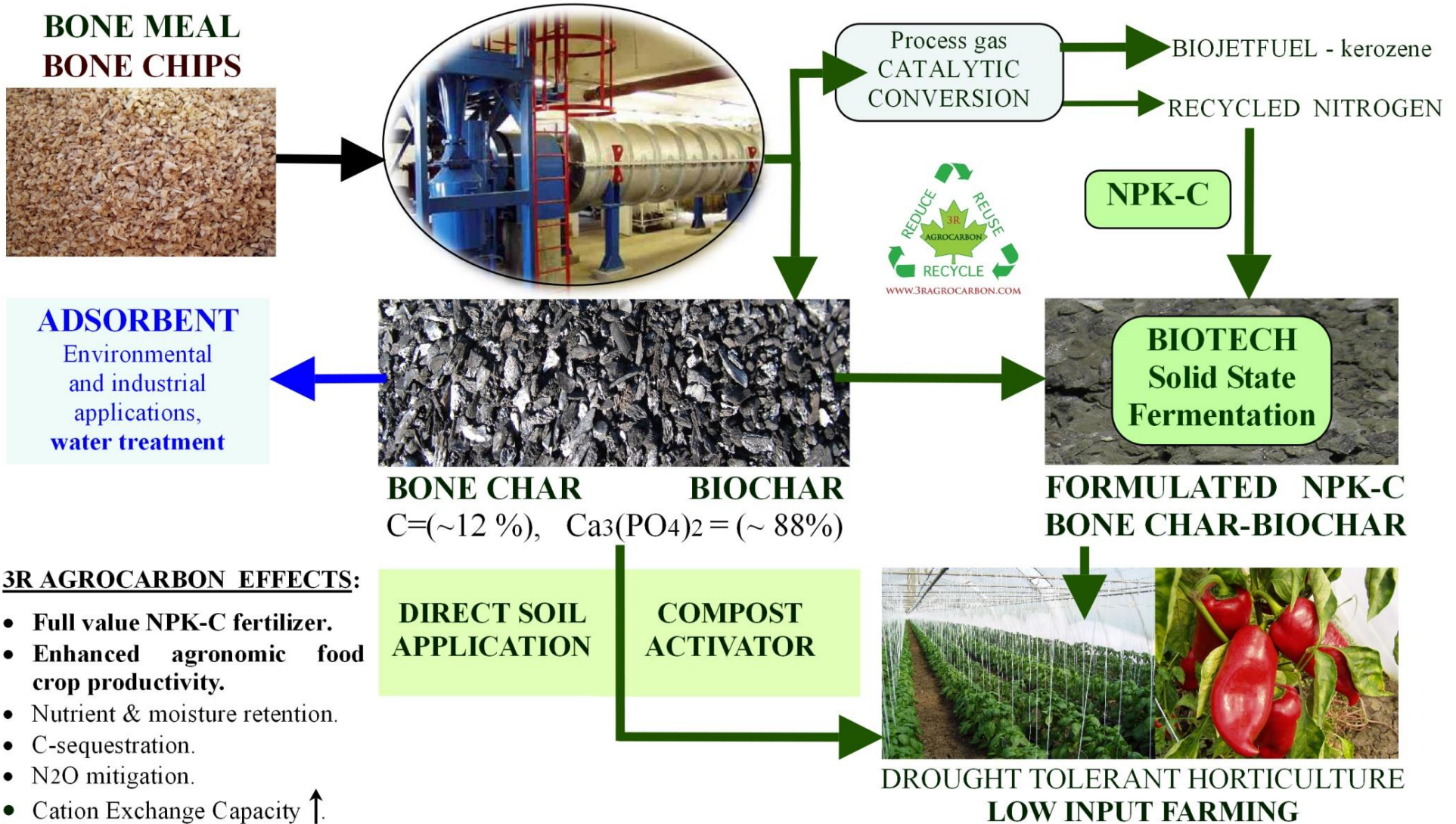
The applied BC tech performance is the key definition factor for BC qty



Recycling of animal bone into concentrated natural phosphate mineral bio-fertilizer

<http://www.agrocarbon.com>

"3R" ZERO EMISSION CARBONIZATION PROCESSING



<http://www.agrocarbon.com>





FIELD TRIALS:
Italy, Germany
The Netherlands
Danmark, Hungary
Spain, Ireland
Slovenia



RESULTS:

YIELD: +10-30% ↑

FRUIT QUALITY: ↑

FOOD SAFETY: ↑

- **COST:** highly depending on application strategy.
- **The BC economy** under market conditions is key definition factor.



Main drivers: BC SAFETY & ECONOMY



REFERTIL POLICY SUPPORT - EU LEGAL SITUATION

1. **ONLY MINERAL FERTILIZERS HAVE BEEN REGULATED AT THE EU 28 level** -> Reg. (EC) No 2003/2003.
2. **NATIONAL PROVISIONS** for marketing of FM = 'national fertilisers'



- **ABSENCE of a harmonized system** for all FM.
- The **Fertiliser Regulation does not affect the 'national fertilisers'**.
- **MS SPECIFIC Legislations** → Large differences
- **PRODUCERS CAN CHOSE: 'EC fertilisers' OR 'national fertilisers'**.
- **MUTUAL RECOGNITION** (Reg. (EC) No 764/2008) for **intra-community movement of national registered fertilisers**.
- **National MS LEGISLATIONS ARE NOT IDENTICAL** throughout the EU28 → **POTENTIAL BARRIERS to mutual recognition**.

WHY CHANGING THE EC 2003/2003 REGULATION ?

- All fertilisers sub-categories should be covered = **FULL HARMONIZATION**
- More emphasis **ENVIRONMENTAL CONCERNS** (limits for contaminants)
- More **INNOVATION** lengthy procedure for the introduction of new fertiliser types in Annex I)
- **RELUCTANCE** of authorities and some economic operators to apply **the Mutual Recognition Regulation** for 'national fertilisers'



LIKELY EXTENSION OF THE SCOPE TO...

- Organic fertilisers: digestates, manure ?,...
- **Soil improvers:** liming materials (including certain industrial by-products) peat, **composts**, manure, **bio-char**.
- The **plant and waste derived biochar inclusion into the revised EU Fertilizer Regulation** is still on pending proposal level.
- Growing media
- Plant biostimulants (improving nutrient uptake and nutrient use performance)

WHAT ARE THE MAIN CHALLENGES?

- Ensuring an **EQUIVALENT PROTECTION** of the **ENVIRONMENT, PLANT AND HUMAN HEALTH** throughout the EU with harmonised system of controls **covering all fertilising materials** including mineral fertilisers, organic fertilisers and soil improvers.
- **GUARANTEE** to farmers **fair information and reliability** about the efficiency and minimal nutrient content (product and producer's responsibility)
- **INTRODUCE** more detailed environmental and human health safety requirements.
- Establishing **ESSENTIAL SAFETY** and **AGRONOMIC EFFICIENCY REQUIREMENTS** for all fertilizer and soil improvement materials.

Wide range of fertilizer and soil improvement materials considered



SAFETY ISSUE

CURRENT LEGAL SITUATION:

- Article 14(c) of current Fertilisers Reg. (EC) No 2003/2003: “A type of fertiliser may only be included in Annex 1 if: [...] (c) under normal conditions of use it does not adversely affect human, animal, or plant health, or the environment” but it **does not include a detailed methodology on how to address these risks.**

FURTHER REVISION IS NEEDED:

- to introduce more detailed environmental safety requirements.

PROBLEMS & CHALLENGES:

- **The term ‘safety requirements’ is neither defined in the EU legislation nor is a common understanding in place.**
- **ABSENCE of an accepted risk assessment methodology.**
- Complexity of the safety and a lack of common understanding of what safety assessments should include.



What is SAFETY?



THE 7 BIOCHAR POLICY OPTIONS

1. BASELINE SCENARIO (**NO POLICY CHANGE**) – national legislation coexists with the EU legislation. – **not suitable for biochar regulation**
2. **REPEAL** of the existing **2003/2003 Reg.** reliance on other existing EU and national legislation. - **not suitable for biochar regulation**
3. **VOLUNTARY COMMITMENT BY INDUSTRY** in addition to existing legislative framework. - **not suitable for biochar regulation**
4. **FULL HARMONISATION OF FM - BASED ON THE CURRENT FORMAT** of 2003/2003 Reg. – **no flexibility – limited alternatives – not supporting innovative but safe solutions.**
5. **FULL HARMONISATION** for all FM – **AUTHORISED LIST OF INGREDIENTS AND ADDITIVES.** – made for chemical industry and not suitable for bio-substances with substantial variations.
6. **FULL HARMONISATION** for all FM – **NEW APPROACH, SAFETY REQUIREMENTS:** Human and animal safety, respect of the environment, **AGRONOMIC CRITERIA – best suitable for biochar adaptation and safe regulation**
7. **COMBINATION OF 1-6.** - **over-complex**

Full harmonization proposed for the BC



DISTINCTION should be made BETWEEN ANIMAL BONE BIOCHAR (ABC) AND PLANT BIOCHAR

Plant biochar:

- >90% w/w high carbon content plant origin
- micro and meso porous (1 nm – 50 nm) carboniferous product,
- high water holding and nutrient retention capacity and C sequestration,
- no soil fertilization effects. **Can be recognised as soil improver? YES**

ABC: Animal Bone bioChar – slow release organic fertilizer

- The input **animal bone meal** is food grade category 3 rendering by-product with economical importance, produced in large industrial scale (2-3 million t/y) which **concentrated high P content apatite** is an critically and strategically important inside EU natural and **RENEWABLE RESOURCE**.
- <20% w/w **low carbon and high calcium phosphate/ apatite mineral content**
- macro porous (50 nm – 63k nm)
- **Containing significant amount of MINERAL nutrients.**
- **Can be recognised as organic fertiliser? YES**



RATIONALE FOR REFERTIL RECOMMENDED LIMIT VALUES AND QUALITY CRITERIA FOR BIOCHAR PRODUCTS

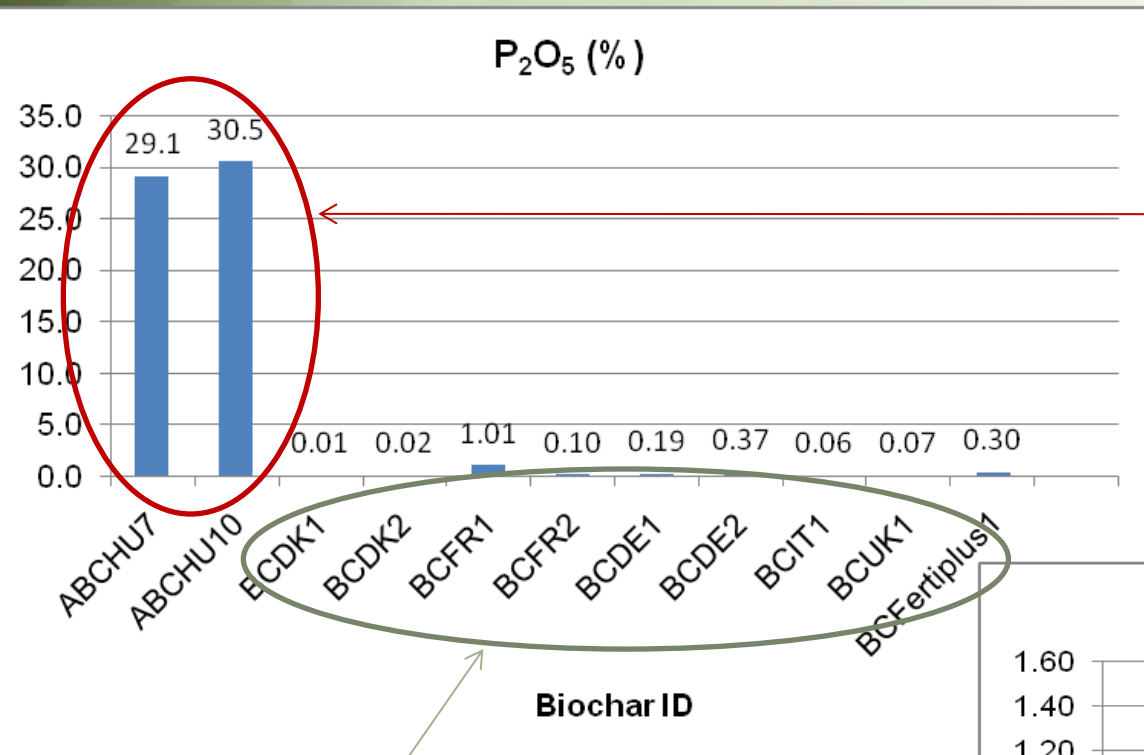
- SAFETY & QUALITY:** There should be no overall adverse environmental, ecological and human health impact from the use of biochar products in the open soil environment:
 - Clear and strict definition of the biochar product quality.
 - Clear and strict definition of the limit values for contaminants:
 - **PAHs:** Target pollutants - key indicator.
 - **TEOC:** Total Extractable Organic Compounds **Marker Index** - biochar production performance key indicator.
 - **Heavy metals:** Heavy metal target pollutants key indicator.
 - **PCB₇:** indicator also for PCDD/F.
- MARKET REGULATION:** poor quality biochar products must exclude from the soil improver/organic fertiliser market.
- AUTHORITY CONTROL:** Authority permits (according to EU/MS regulations) + REACH for production and use biochar over 1 t/y capacity.
- BIOCHAR PRODUCTION** criteria for safe biochar production.
- BIOCHAR ECONOMY:** realistic and commercial market demanded economical scenario.



BIOCHAR QUALITY PARAMETERS & NUTRIENTS (SUMMARY)

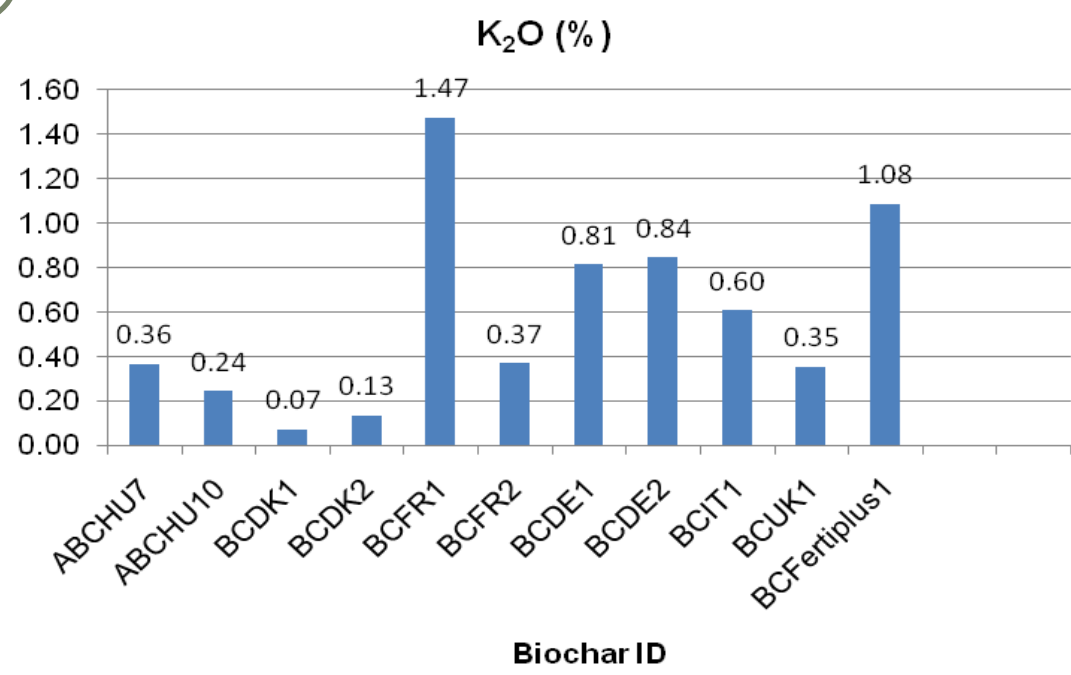
Parameters to be fulfilled	ECBC organic fertilizer Proposed Minimum limit value for ABC animal bone biochar	ECBC soil improver Proposed Minimum limit value for Plant Biochar
Minimum organic matter content (expressed on dry matter)	Total Organic Carbon 7 %	Total Organic Carbon 50 %
Marker index and production performance indicator. TEOC Marker index Total Extractable Organic Compounds (marker index)	500 mg/kg (preliminary)	500 mg/kg (preliminary)
Molar H/C ratio	-	<0.7
pH	6.5 - 9.0	6.5 - 9.0
Dry substance content	>80%	>60%
Particle size distribution, mm	Preferably < 5 mm	Preferably <20 mm
Water holding capacity, ml/g	declaration	declaration
Bulk density	declaration	declaration
Nutrient content indicator. Minimum nutrient content on dry matter N-P-K	N Total: declaration P ₂ O ₅ total > 25% K ₂ O total declaration	No minimum limit value, declaration
Minimum nutrient content Ca-Mg	No minimum limit value, declaration	No minimum limit value, declaration
Total N (% of dry mass)	declaration	declaration
Total P (% P ₂ O ₅ dry mass)	ABC >25 % p ₂ o ₅	declaration
Total K (% , dry basis)	declaration	declaration
Total Ca (% , dry basis)	declaration	declaration
Total Mg (% , dry basis)	declaration	declaration

NUTRIENT CONTENT OF BIOCHARS

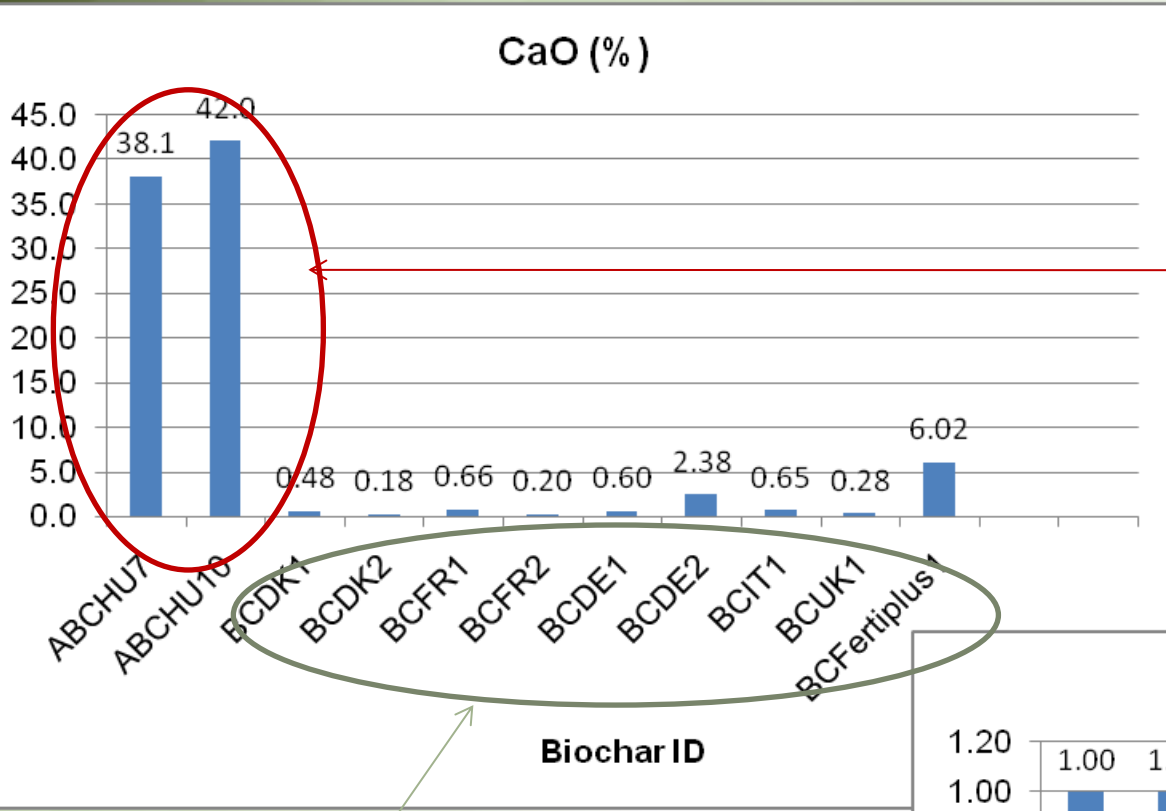


Animal Bone bioChar
ABC total P substitution potential EU28 = <20%, in realistic potential 5-10 %.

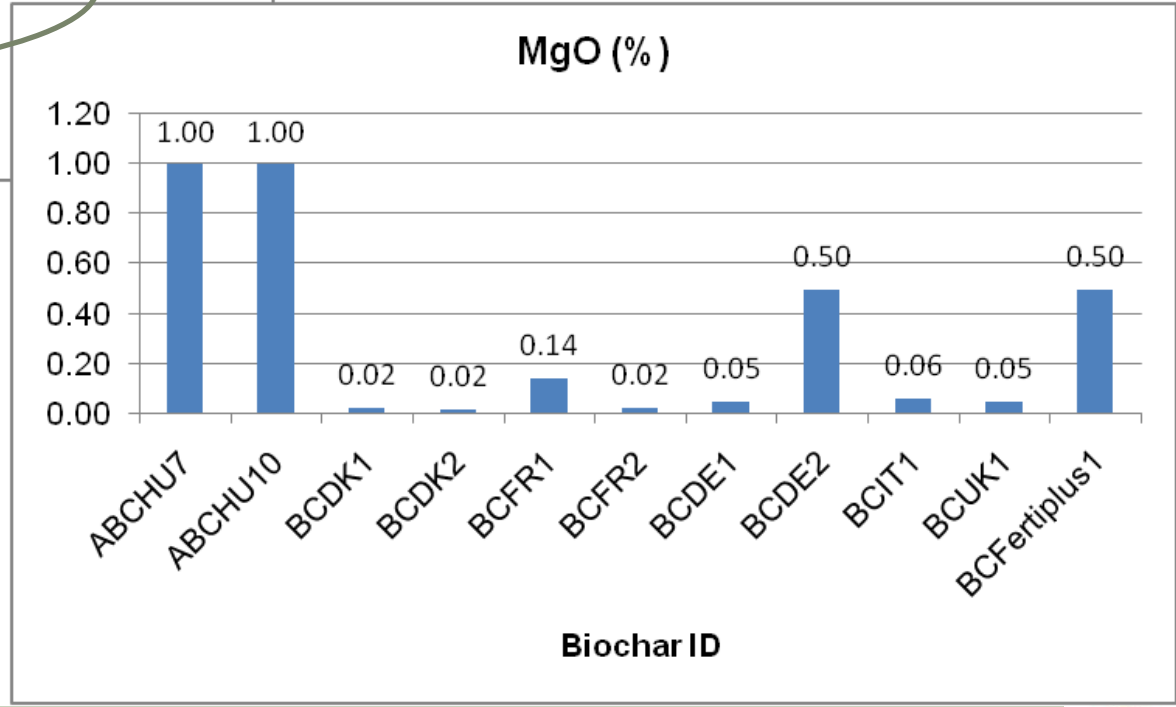
Plant base biochars
No nutrient content with economical value



NUTRIENT CONTENT OF BIOCHARS



Animal Bone bioChar



Plant based biochars
No nutrient content with
economical value

REFERTIL RECOMMENDED LIMIT VALUES FOR HEAVY METALS AND ORGANICS



ORGANIC FERTILIZER AND SOIL IMPROVER PRODUCT LEGISLATIONS

1. **At the EU level there is no legislation which maximizing the heavy metal and organic content of biochar products.**
2. **Sewage Sludge Directive (86/278/EC)** includes limit values for 7 heavy metals. Does not include PAHs, PCBs and PCDD/F. Several **MS have implemented stricter limit values for heavy metals and set requirements for other contaminants.**
3. **EU Eco Label Regulation** (voluntary) and **Organic Farming Regulation** are setting up threshold values only for **the heavy metal content of fertilizer materials.**
4. **End-of-waste criteria** on Biodegradable waste subject to biological treatment (JRC 2013) is setting up limit values for **7 heavy metals and PAH₁₆** in the compost/digestate products.
5. Both EU and world wide level different **private voluntary standards** (IFOAM accredited) are existing for setting up **threshold values for the heavy metal content of organic fertilizers** which can be used for organic farming production.

Several legislations to be considered



LIMIT VALUES FOR HEAVY METALS IN DIFFERENT EU/MS AND SWISS LEGISLATIONS AND STANDARDS

LEGISLATION/STANDARD	Cd	Cr (tot)	Cr VI	Cu	Hg	Ni	Pb	Zn
	mg/kg dm							
Sewage Sludge Directive 86/278/EEC <i>(Several MS have enacted and implemented stricter limit values)</i>	20-40	x	x	1000-1750	16-25	300-400	750-1200	2500-4000
Sewage Sludge Directive Revision Working document on sludge and biowaste (2010)	10	1000	x	1000	10	300	500	2500
EU ECO Label	1	100	x	100	1	50	100	300
EoW (Draft final report) Compost/digestate	1.5	100	x	200	1	50	120	600
Organic farming Reg. (EC) No 889/2008 , Reg. (EC) No 834/2007	0.7	70	0	70	0.4	25	45	200
Chemical Risk Reduction Ordinance , ChemRRV, SR 814.81)2005 Switzerland	1	x	x	100	1	30	120	400
Compost Quality Assurance (RAL-GZ 251), Germany	1.5	100	x	100	1	50	150	400
Fertiliser Ordinance (DÜMV, 2003) Germany	1.5	x	2	x	1	80	150	x
Fertiliser Act Netherlands "Clean"	1	50	x	60	0.3	20	100	200
BSI PAS 100:2011 BSI Specification for composted material UK	1.5	100	x	200	1	50	200	400
Naturland Private organic labels standard , DE+ Worldwide Compost	0.75	75	x	50	0.5	30	75	200
Soil Association organic standards (private voluntary standard) Compost from source separated greenwaste, UK	1.5	x	100	200	1	50	200	400

SUMMARY OF THE REFERTIL RECOMMENDED LIMIT VALUES FOR TOXIC CONTAMINANTS

Parameters to be fulfilled	ECBC organic fertilizer Proposed Minimum limit value for ABC animal bone biochar	ECBC soil improver Proposed Minimum limit value for Plant Biochar
Germination Inhibition Assay	mandatory no germination inhibition	mandatory no germination inhibition
<u>Phytotoxicity</u>	mandatory not <u>phytotoxic</u>	mandatory not <u>phytotoxic</u>
Limited content of macroscopic impurities	mandatory declaration	mandatory declaration
Target pollutants. Limited content of heavy metals	Zn: 600 mg/kg dm Cu: 100 mg/kg dm Ni: 50 mg/kg dm <u>Cd</u> : 1 mg/kg dm <u>Pb</u> : 120 mg/kg dm Hg: 0.5 mg/kg dm Cr (VI) 0.5 mg/kg	Zn: 600 mg/kg dm Cu: 100 mg/kg dm Ni: 50 mg/kg dm <u>Cd</u> : 1 mg/kg dm <u>Pb</u> : 120 mg/kg dm Hg: 0.5 mg/kg dm Cr (VI) 0.5 mg/kg
Product and environmental quality indicator. Target pollutants. PAH ₁₆	6 mg/kg dm Target organic pollutant. Maximum allowable dose input per ha area recommended on regional MS level.	6 mg/kg dm Target organic pollutant. Maximum allowable dose input per ha area recommended on regional MS level.
Contamination indicator. PCB ₇	0.1 mg/kg dm	0.1 mg/kg dm
PCDD/F	<20 <u>ng/kg</u> I-TEQ mandatory only if PCB >0.07 mg/kg <u>not</u> target pollutant.	<20 <u>ng/kg</u> I-TEQ mandatory only if PCB >0.07 mg/kg <u>not</u> target pollutant.

Comparison of the limit values for heavy metals and organics in the different EU legislation-legislation proposals and Biochar standards

Contaminants	EU Legislation			EU legislation proposal		Biochar Standards					
	Org. Farm	Eco Labels	Directive 86/278/EEC Sewage Sludge	EoW (final draft)	Proposal Sludge	IBI (USA)	BQM (UK)		EBC (CH)		ECBC REFERTIL
							high grade	Standard	base	premium	
mg/kg dm											
As	-	10	-	-	-	12-100	10	100	-	-	-
Cd	0.7	1	20-40	1.5	10	1.4-39	3	39	1.5	1	1
Cr (total)	70	100	-	100	1,000	64-1,200	15	100	90	80	100
Cr (VI)	0	-	-	-	-	-	-	-	-	-	0.5
Cu	70	100	1,000-1,750	200	1,000	63-1,500	40	1500	100	100	100
Hg	0.4	1	16-25	1	10	1-17	1	17	1	1	0.5
Ni	25	50	300-400	50	300	47-600	10	600	50	30	50
Pb	45	100	750-1,200	120	500	70-500	60	500	150	120	120
Zn	200	300	2,500-4,000	600	2,500	2,000-7,000	150	2,800	400	400	600
PAH	-	-	-	6	6	6-20	20	20	4	12	6
PCB	-	-	-	-	0.8	0.2-0.5	0.5	0.5	0.2	0.2	0.1
PCDD/F5 (ng/ITEQ/kg)	-	-	-	-	100	9	20	20	20	20	20

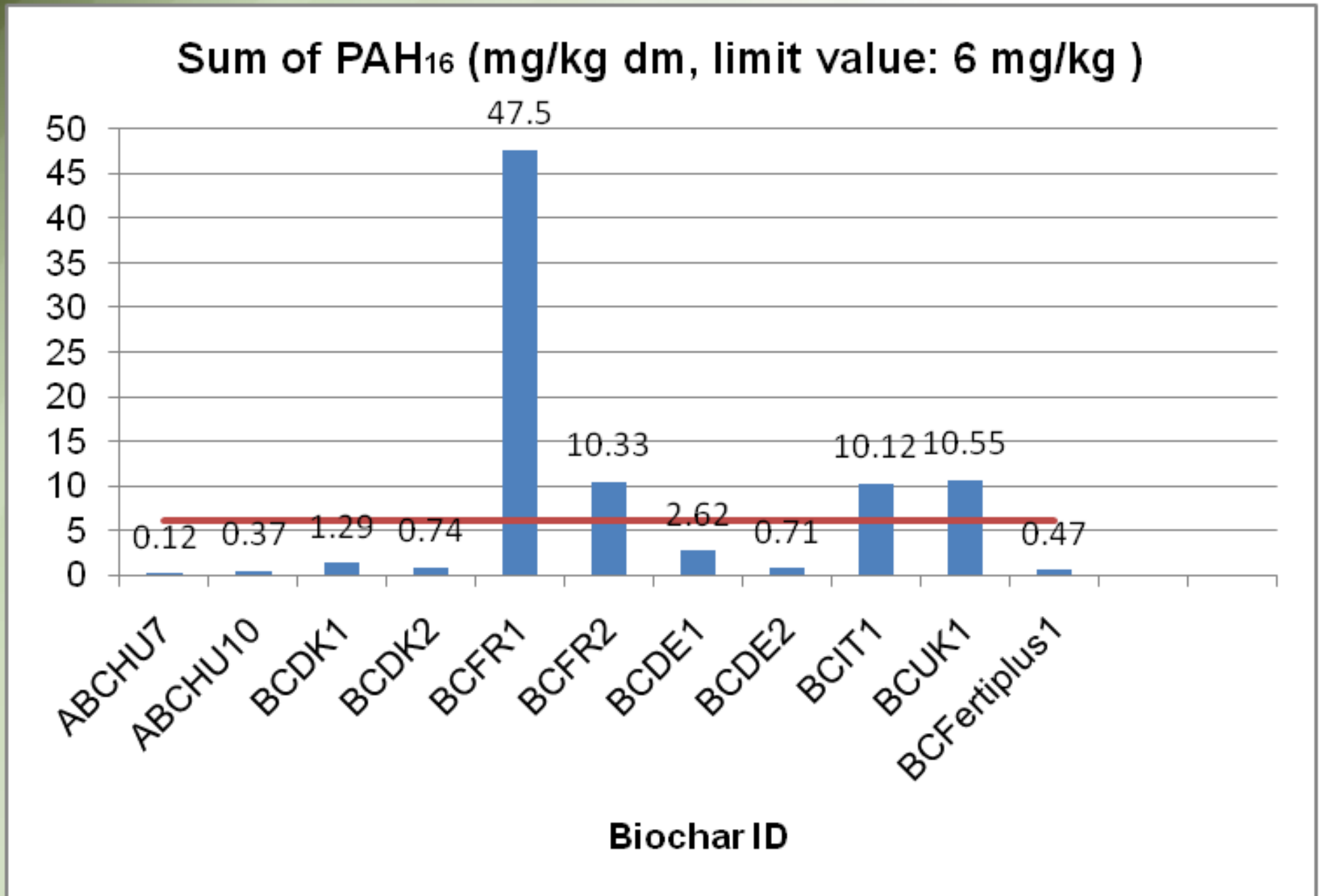
IBI, BQM, EBC = VOLUNTARILY CERTIFICATIONS ECB = FR proposal mandatory



Different BC standard concepts



PAHS – TARGET CONTAMINANTS IN BIOCHAR



PAH is fingerprint of the technology design and performance



TARGET ORGANIC POLLUTANT: PAHs

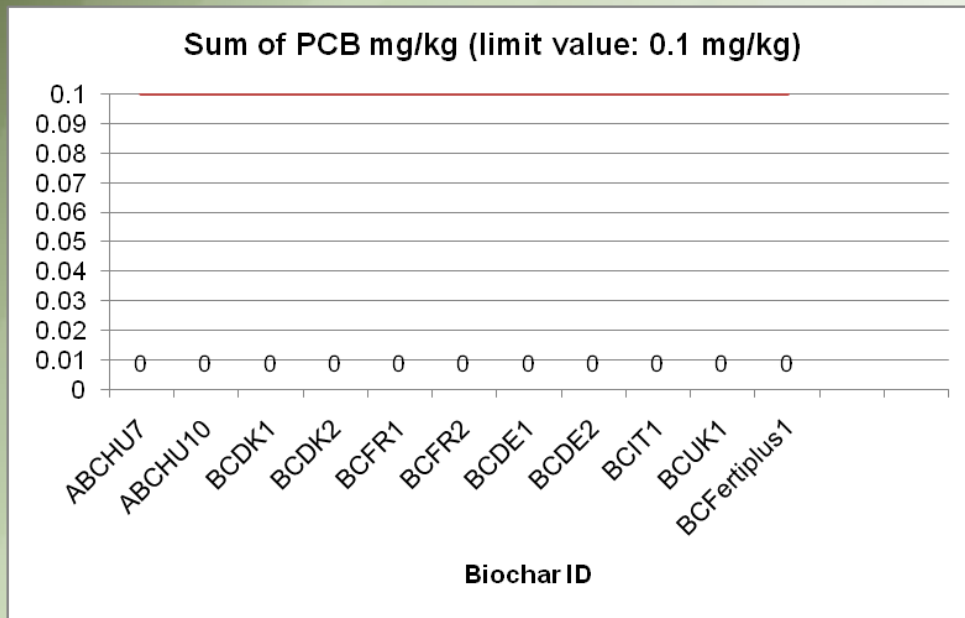
- **The PAHs primarily derive from:**
 1. **obsolete, low grade and inefficient pyrolysis condition**
 2. contaminated and/or improper selected feedstocks.
- **The sub-optimal pyrolysis conditions reduce the product benefits and enhance the risk of land and water contamination.**
- If the nutrient content is low (plant biochar), there is **a risk that large amounts of respective product could be used for a certain area to supply the plants with sufficient nutrient.**
- **Higher application dosage = higher PAH loads to the agricultural land.**

Reducing the risk of PAH contamination by:

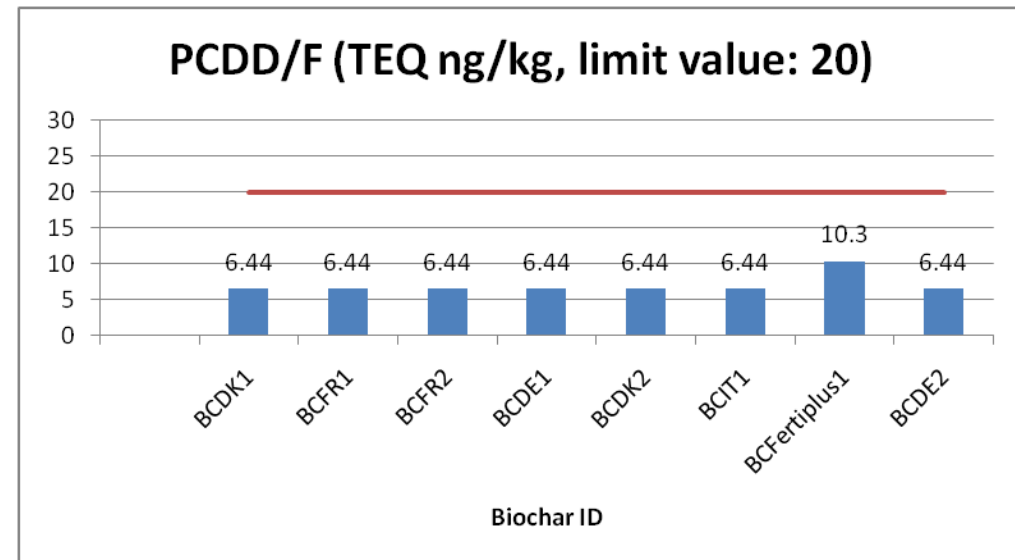
- tight control on pyrolysis condition
- standardized biochar production (pyrolysis).
- **specific condition and rules for biochar application.**
- Setting up a safe application rate (t/ha dosage) for plant base biochar (= **LIMIT BASED ON AMOUNT**) to prevent negative impacts from the contaminants.



PCBs AND PCDD/F – NOT TARGET CONTAMINANTS IN BIOCHARS



- PCBs and PCDD/F are not target contamination in any type of biochar, but PCB is contamination indicator



CONCLUSIONS & RECOMMENDATIONS I.

1. **Plant based biochar is a soil improver, doses expected at 5 t/ha but max. 20 t/h.** The economy is the key driver.
2. **ABC animal bone biochar is organic fertilizer 200 kg/ha up to max. 1000 kg/ha** recommended doses.
3. **There is need for tight policy and regulations in respect to sustainable biochar feed material supply – biochar production – biochar import - handling – application.**
4. Recommendation for minimalization of toxic contaminants:
 - setting up a safe application rate mg/kg on EU level and
 - specific targeted area kg/ha dosage and background contamination determination is based on MS level for minimizing the risk from heavy metal in soil and PAH loads with water pollution potential.

Q: will plant based BC included into the new FR or need further considerations?



CONCLUSIONS & RECOMMENDATIONS – II.

4. **PCBs and PCDD/F are not target contamination in any type of biochar, but PCB is contamination indicator.**
5. **PAHs - TEOC are target contaminations, BC QTY key indicators.**
6. The BC technology design and processing performance are the most important ultimate definition factors for biochar quality and safety.
7. **Low tech biochar technology processing performance and conditions resulting low quality carbon product with high PAH/TEOC load.**
8. The REFERTIL consortium **is not recommending the nutrient recovery as biochar from any sewage sludge. For waste derived BC DG-ENV is the key partner.**



Q: will plant based BC included into the new FR or need further considerations?



CONCLUSIONS & RECOMMENDATIONS – III.

9. **Bone biochar recommended to be added to the Annex I. of Regulation (EC) No 889/2008 as organic Phosphorus fertilizer.** Plant biochar recommended to be added to the Annex I. of Regulation (EC) No 889/2008 as organic soil improver.
10. **All biochar that meets the ECBC European Community BioChar criteria, also fully meet the European Ecolabel criteria system and can be registered as Ecolabel product.**
11. All biochar material (manufactured, imported or used) in > 1 t/year quantity (2018), has to be registered under Article 6 of the REACH Regulation, which is to be applied together with the other EU regulations.



FERTILIZER REGULATION REVISION

- Initiated 2010. Preparations 2010-2013
- Important EU top level meeting and decision **November 20, 2013**. If green light OK for FP proposal than legal formulate 2014.
- **If all goes well FR completed around 2016.**
- **If the high carbon content plant based BC soil improver will not be included into the mandatory new FR legislation now in 2013 and before mid 2014, than there is a risk that plant based BC case industrial applications will be pending for long time.**
Voluntarily BC certificates are far less powerful under market conditions and from MS Authority permit point of view than mandatory EU Regulation.
- ABC is clear case with long application references.



HIGH CARBON CONTENT PLANT BASED BIOCHAR ECONOMY: INTEREST AND BENEFITS FOR THE SME and FARMERS

- Farmers' behaviour
- Selling points
- Actual char prices
- Needed yield effect
- Conclusions



Why should the farmer buy plant based Biochar?

Increased yield:

- Better utility of nutrients
- Soil improvement
 - Increased water holding capacity
 - Easier and better establishment of crops

Reduce costs of:

- Mineral fertilisers
- Liming
- Pesticides

Qualify for environmental subsidy (?)

**Long term: Maintaining soil fertility,
Potential for C sequestration**



Application rates and current price level of chars

Application rates

Literature: Jeffrey et al.*

- Tested: 782 replicates from 1.5 t/ha to 100 t/ha
- In average: +10% extra yield (-55% to +65%, year 1)

REFERTIL - field trial 2013/14

- 3 - 25 t/ha from wood
- Price: 500 Euros/t
- No effect on yield year 1

Current prices, excl. transport and application costs

- 100 Euros per ton – 1,000 (>2,000) Euros per ton
- Application of 3 to 10 t/ha: An investment of 300 – 10,000 Euros per ha

High C content plant based biochar costs of 300 – 10,000 Euros per ha compared to current costs of input



Yearly costs in the conventional agricultural cereal production:

- Fertilisers: 250 – 400 Euros per ha
- Pesticides: 40 – 100 Euros per ha
- Liming: 20-30 Euros per ha per year (every 6-7 year)
- Other C-sources: Straw, catch crops

How big is the effect on the yield?

And for how long a period can we calculate a yield effect from biochar?

How much is the farmer willing to invest?

- The farmer usually invests in his fields on a short-term basis: The farmer expects to obtain full yield value of the costs for nutrients and spraying every year (approx. 400 Euros/ha)
- Unless very well documented yield effect to similar soil types, he will not spend more than 100 -150 Euros per ha on a new product



Calculations of PBCwood (BCDK1)

Needed yield effect to pay the char at different time frames and application doses

- P: 0.2 kg/t
- K: 1.2 kg/t
- C/N: 320
- Char price: 500 Euros/t
- Cereal: 202 Euros/t

Dose		2.9 t char (2.5 t C/ha)	5.75 t char (5t C/ha)	11.5 t char (10 t C/ha)	23 t char (20 t C/ha)
	Years	Extra yield, t per hectare			
Interest on dept. (ex. repayment)		0.36	0.71	1.4	2.8
Depreciation	10	0.9	1.8	3.6	7.1
	20	0.54	1.1	2.1	4.3
	30	0.42	0.83	1.7	3.3

Rate of interest : 5%

Calculations of PBCstraw (BCDK2)

Needed yield effect to pay the char at different time frames and application doses

- P: 5 kg/t
- K: 4.2 kg/t
- C/N: 120
- Char price: 100 Euros/t
- Cereal: 202 Euros/t

Dose		3.2 t char (2.5 t C/ha)	6.4 t char (5t C/ha)	12.7 t char (10 t C/ha)	25.5 t char (20 t C/ha)	
	Years	Extra yield, t per hectare				
Interest on dept (ex. repayment)		0.07	0.14	0.27	0.54	
Depreciation		10	0.17	0.34	0.68	1.35
		20	0.10	0.20	0.41	0.81
		30	0.08	0.16	0.32	0.63

Rate of interest : 5%

Conclusions:

Soil improvement is a long-term investment, fertilising is a short time investment

1. Soil improvers:

- High C input material: Wood, straw etc.
- If the problem is acid soils, liming is far the cheapest
- Is as soil improvement probably only interesting at sandy soils with very low water holding capacity
- Max. price for field crops 100 Euros per ton. Catch crop/straw/manure are alternatives
- Wood char at current prices might be used as growth media in intensive horticulture

Conclusions

2. Soil improvers and fertilisers:

- Char from: Slurry fibres, manure, deep litter from chickens etc.
- From an economic point of view the max. price for field crops is 100 – 200 Euros per ton, relevant for both conventional and organic farming
- Higher prices can be justified when used as fertiliser/growth media in intensive horticulture

Conclusion

There is a need for further documentation of the value of high C content chars in different crops on different soil types and under different climatic conditions for soil improvement.

Also the practical handling needs to be solved

- Formulation?
- How to apply?
- Depth of incorporation?
- Technique?
- Etc.



ABC Animal Bone bioChar Economy

- ABC is not under the WfD/EoW.
- **EU GVT Authority permitted industrial process.**
- **EU GVT Authority permitted product** (permit 2005 – 2009).
- Input is food grade animal bone meal.
- **Premium slow release organic fertilizer** in many different “as Customer needed” formulations incl soil biotech formulated substance.
- Target applications are the added value **horticultural** industry and **adsorption** techniques.
- Developed for **both for soil and soilless cultivations**. Same grain size as usual fertilizer 1-4 mm, dose rate from 200 kg/ha, average 400 kg/ha.
- Manufacturing of ABC requires far higher and advanced technological science-technology-industrial engineering level than to make plant based biochar.
- Meet 2010/75/EU (industrial emission, Jan 7, 2014 and BAT.
- **Standard industrial scale 20,000 t/y input food grade bone meal.**
- **Return on investment for production and applications <3 years.**

€€ - \$\$ ABC ROI = <3 years €€ - \$\$





INVITATION:
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June 2015, Brussels

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The REFERTIL (289785) Collaborative project is co-funded by the European Commission, Directorate General for Research, within the 7th Framework Programme of RTD, Theme 2 - Food, Agriculture and Fisheries, and Biotechnology.



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DEVELOPMENT FUND

THANK YOU!



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