Version 21/04/2016

COST Action TD1107

Biochar as option for sustainable resource management

FINAL ACHIEVEMENT REPORT
(26.03.2012 – 25.03.2016)

This report on the full lifetime of the Action is submitted by the MC Chair on behalf of the Management Committee.

Executive summary of the Achievement Report:

Strategies of sustainable use of natural resources including organic waste helps the EU mitigating greenhouse gas emissions, while industries and farmers benefit from new markets, opportunities and use of improved soils, e.g. for biofuel production without endangering food supply.

Biochar is obtained by thermochemical conversion of organic residues with the purpose of soil addition. During COST Action TD1107 (Biochar as option for sustainable resource management), a European Biochar Research Network (eBRN) was established connecting European Biochar researchers, technologists, and stakeholders. Four working groups focused on (i) Biochar production and characterization, (ii) land use implementation, (iii) economic analysis including life cycle assessment, and

(iv) environmental impact assessment. Progress was achieved towards implementation of sustainable use of natural resources including biochar in order to maintain or improve of soil quality, while efficiently sequestering carbon in the long-term. This was accomplished by annual Biochar Workshops, Short-Term Scientific Missions of young Biochar researchers, four Biochar Training Schools, numerous peer-reviewed scientific papers, and an internet platform to monitor and streamline Biochar R&D.

Integration of European Biochar field and greenhouse experiments was achieved using an online survey. Evaluation of over hundred greenhouse and field experiments revealed mostly positive biochar response on plant growth, plant-available water holding capacity, and plant phosphorus nutrition, while about half of the experiments showed negative effects on plant nitrogen supply.

Another highlight was a discussion with stakeholders about new biochar-based growing media as peat replacement. Although peat is not limited on a global scale yet, peatlands are among the most threatened habitats in some European countries and attempts were undertaken to preserve and restore remaining peatlands. Both growing experiments and company interviews indicated that biochar might play a more important role in replacing peat in growing media, when biochar is commercially available and meets required quality standards and their use is economically feasible.

Furthermore, biochar legalization was intensively and controversially discussed within the eBRN and with other stakeholders such as the European Sustainable Phosphorus Platform and the European Commission with the result that biochar is included in Annex A of the new European fertilizer directive now.

Last but not least, key priorities in biochar research for future guidance of sustainable policy development were identified by expert assessments. Current level of scientific understanding indicates that the most critical topics for future research regarding biochar soil application are functional redundancy within soil microbial community, bioavailability of biochar's contaminants to soil biota, soil organic matter stability, greenhouse gas emissions, soil formation, hydrological cycle and soil water supply to plants, microbial priming and modifications of the rhizosphere microbiome, and plant uptake of pollutants and soil pH buffering capacity. We hope that our identified gaps in the current level of scientific understanding, along with the identified key issues, will be prioritized by scientists in order to reach the required level of scientific understanding for the development of sustainable biochar application systems for practical users of biochar.

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I. Achievement Report

I.A. COST Action Profile

Objective/ Aim

The main objective of the Action is to expand and interconnect knowledge in Biochar systems, to assess environmental impacts of Biochar use and thus sharpen a promising global change mitigation tool up to the stage where economically feasible application will begin

Details

MoU:	4184/11	Start of Action:	26.03.2012
CSO approval date:	01.12.2011	End of Action:	25.03.2016

COST Member Countries and Cooperating State having accepted the MoU

Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom

Intentions to Accept the MoU

Bulgaria

Other participants:

Institution Name	Country
Agrophysical Research Institute	Russian Federation
University of Sidney	Australia
University of Stellenbosch	South Africa

Contacts

Chair/ Vice Chair

Position	Name	Contact details	Country	Date of PhD	Gender
Chair:	Prof. Dr. Bruno Glaser	Institute of Agronomy and Nutritional Sciences, Soil Biogeochemistry Martin-Luther-University Halle-Wittenberg, Germany bruno.glaser@landw.uni-halle.de	Germany	1999	Male
Vice Chair:	Prof. Dr. Heike Knicker	Instituto de Recursos Naturales y Agrobiología de Sevilla Av. Reina Mercedes 10 Sevilla 41012 Spain	Spain		Female
	Dr. Ellen Graber	Institute of Soil, Water and Environmental Sciences The Volcani Center, ARO POB 6 Bet Dagan 50250 Israel	Israel		Female

Working Group Leaders

WG#	WG Title	WG Leader	Country	Date of PhD	Gender	Number of participants
1	Biochar production and characterisation	Hans-Peter Schmidt	Switzerland Spain		Male Female	92

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		Prof. Dr. Heike Knicker				
2	Land use management	Dr. Frank Verheijen Prof. Dr. Constanza Zavalloni	Portugal Italy	2005 2004	Male Female	56
3	Economic analysis including life cycle assessment	Dr. Nele Ameloot Prof. Dr. Saran Sohi	Belgium UK	2014 2001	Female Male	36
4	Environmental impact assessment	Dr. Juergen Kern Dr. Ruben Sakrabani	Germany UK		Male Male	51

Other positions if applicable (STSM Coordinator, WG Vice Leader, Task Force Leader…)

Position	Name	Country	Date of PhD	Gender
STSM manager	Prof. Dr. Claudia Kammann	Germany		Female
Gender balance manager	Dr. Ellen R. Graber Dr. Utra Manakasingh	Israel Island		Female Female

Action website:	http://cost.european-biochar.org

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I.B. Achievement of MoU objectives and deliverables and additional outputs

MoU objectives

MoU objective	Achieved Yes/ Partially/ No	Evidence of (partial) achievement
Systematize essential knowledge to optimize Biochar production ("designer Biochars") with regard to its properties and effects, considering the large range of suitable biomass, energy and mass balances, cost efficiency and Biochar quality	Yes	Glaser B. and Schimmelfpennig S. (2012) One step forward toward characterization: some important material properties to distinguish biochars, Journal of Environmental Quality 31, 1001-1013. http://dx.doi.org/10.2134/jeq2011.0146 Ronnse F. et al. (2013): Production and characterization of slow pyrolysis biochar: influence of feedstock type and pyrolysis conditions. Global Change Biology Bioenergy 104-115. http://dx.doi.org/10.1111/gcbb.12018 Visser R. et al. (2016) Biochar Production Technology: designing biochar properties. Journal of Environmental Engineering and Landscape Management, in preparation.
Develop an EU road map to produce 140 million tons of Biochar annually by processing 500 million tons of organic residues, offsetting 10% of the European fossil fuel use	Partially	Kern J. et al. (2016) Synergetic use of peat and char materials in growing media – one option reducing the pressure on peatlands? Journal of Environmental Engineering and Landscape Management, under review.
Systematize and integrate knowledge to identify the most beneficial Biochar use strategies in agriculture across various European regions and climates, identifying the most promising applications	Yes	Systematic evaluation of biochar field and pot trials across Europe (Publications in preparation being part of the COST Action's final publication) Map of biochar field experiments across Europe: http://cost.european-biochar.org/en/projects/map Peresotti A. et al. (2016) Biochar use in temperate and tropical agriculture, animal husbandry and organic fertilizer management. Journal of Environmental Engineering and Landscape Management, in preparation. Sakrabani R. et al. (2016) Representativity study pot experiments. Journal of Environmental Engineering and Landscape Management, in preparation. Verheijen F. et al. (2016) Representativity study field experiments. Journal of Environmental Engineering and Landscape Management, in preparation.
Identify a comprehensive strategy for the most efficient use of Biochar to maintain and improve C sequestration and soil fertility	Yes	Shackely S. et al. (2015) Biochar in European Soils and Agriculture. Science and Practice. Routledge. https://www.routledge.com/products/9780415711661 Sohi S. et al. (2016) Time matters: Biochar persistence in soil and its effects on SOC stocks. Journal of Environmental Engineering and Landscape Management, in preparation.
Evaluate potential threats accompanying the use of Biochar in soils. According to the European Community Regulation on	Yes	Bucheli T. et al. (2016) The Janus face of Biochar: Risk of pollution versus pollution remediation tool? Journal of Environmental Engineering and Landscape Management, in preparation.

chemicals and their safe use (REACH), safety information on Biochar will deal with toxic compounds (i.e. PAHs, heavy metals) and their effects on plant, animal and human health (e.g. genotoxicity) and effects on GHG emissions (i.e. N2O, CH4, CO2)		Kammann C. et al. (2016) Biochar use for reducing GHG (N2O, CH4) emissions in soils, substrates and animal production. Journal of Environmental Engineering and Landscape Management, in preparation.
Evaluate potential benefits in detoxification strategies where Biochar is used to adsorb organic pollutants or heavy metals in soils or animal feed	Yes	Fristák, V. et. al. (2014) The response of artificial aging to sorption properties of biochar for potentially toxic heavy metals, Nova Biotechnologica et Chimica, 13, 137–147. http://dx.doi.org/10.1515/nbec-2015-0004 Fristák, V. et al. (2015) Effect of biochar artificial ageing on Cd and Cu sorption characteristics. Journal of Geochemical Exploration 159, 178-184. http://dx.doi.org/10.1016/j.gexplo.2015.09.006
Systematize current risks vs. benefits understanding to put forward "best practice" recommendations in preparation for legislation requirements	Yes	Meyer S. et al. (2016) Biochar harmonization and legislation. Journal of Environmental Engineering and Landscape Management, under review.
Provide target group-specific recommendations on how to use the knowledge provided about Biochar efficiently	Yes	Tammeorg P. et al. (2016) Biochars in soils: Towards the required level of scientific understanding. Journal of Environmental Engineering and Landscape Management, under review.
Identify common (EU) R&D targets with respect to Biochar aspects	Yes	Tammeorg P. et al. (2016) Biochars in soils: Towards the required level of scientific understanding. Journal of Environmental Engineering and Landscape Management, under review.
Promote public information transfer to enable use of state-of-the art knowledge	Yes	EBRN website: http://cost.european-biochar.org/en

MoU deliverables

MoU deliverable	Delivered Yes/ Partially/ No	Evidence of (partial) delivery
D1: Harmonized definition of Biochar types based on material properties, on feedstock and production process and intended use (report)	Yes	Meyer S. et al. (2016) Biochar harmonization and legislation. Journal of Environmental Engineering and Landscape Management, under review
D2: Standardized protocols for characterizing relevant properties, functions and risks of Biochar use in soils (report)	Yes	Bachmann et al. (2016) Toward the Standardization of Biochar Analysis: The COST Action TD1107 Interlaboratory Comparison. Journal of Agricultural and Food Chemistry 64, 513−527. http://doi.org/10.1021/acs.jafc.5b05055
D3: Organization of annual European Biochar meetings,	Yes	EBRN website: http://cost.european-biochar.org/en

including the meeting of the target WGs (workshop)		
D4: EU internet knowledge and communication platform for timely and state of the art knowledge transfer for users, decision-makers, stakeholders and the public (website)	Yes	EBRN website: http://cost.european-biochar.org/en
D5: Publication of the Action's results in an annual newsletter (newsletter)	Yes	EBRN website: http://cost.european-biochar.org/en
D6: Publication of the Action's results in peer-reviewed Biochar reviews or synthesis papers (publication)	Yes	See publication list.
D7: Organization of Summer Schools and practical training courses for students, end-users and stakeholders (Summer School)	Yes	EBRN website: http://cost.european-biochar.org/en
D8: Creation of an annually provided "Biochar award" for the most outstanding and innovative contribution to the field of Biochar R&D, the "black-is-green gold prize" in three categories: a) Scientific contribution, b) Technology innovation, c) new ideas for public knowledge transfer (Award)	Partially	Award for best STSM to Tiziana Pirelli
D9: Organization of public-educational ring trials ("easy take away experiments") to spread latest biochar knowledge in the respective contributing country (a) among students (=future young scientists) in cooperation between universities and higher educational schools, and, as a multiplicator (b) among an interested public, performed by the students who communicate their results via the EU COST Biochar web site, via modern social networks and to the public media when presenting their results on public event days (open-door school days, street of experiments festivals, "city of young researchers" or equivalent)	No	-

Co-authored publications and FP7/ H2020 proposals

The co-authored publications and FP7/ H2020 proposals/ projects resulting from the Action are listed on the page following the "Additional outputs and achievements" section.

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Additional outputs and achievements

Please describe any other outputs and achievements, focusing in particular on those that contribute to the COST mission of “COST enables break-through scientific developments leading to new concepts and products and thereby contributes to strengthen Europe’s research and innovation capacities.”

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Co-authored publications and FP7/ H2020 proposals

Co-authored publications

This table contains the (up to) ten most significant co-authored publications resulting from the Action. All publications are on the topic of the Action, co-authored by at least two Action participants from two different countries participating in the Action.

NO.	Bibliographic data (including: Title, Authors, Title of the periodical or the series, Issue number or volume, Publisher, Year of publication, Relevant pages)	Main author	Number of authors	Action participants listed among the authors (Name, country and role[1])	WGs involved in publication	Date of submission (must be after Action start date)	Expected date of publication (if not already published)	Persistent link to publicly available version of the paper (if available) or the abstract	Is/Will open access[2] provided to this publication?	Is/ will COST be cited/ acknowledged in the publication?	Are/ will COST funds (be) implicated in this publication	Relevance to H2020 Societal Challenges[3]?	Is it peer-reviewed?	Was the added value of the Action Networking necessary for the publication	Impact Factor (if applicable)
1	Bachmann, H. J.; Bucheli, T. D. Dieguez-Alonso, A. Fabbri, D.; Knicker, H.; Schmidt, H. P.; Ulbricht, A.; Becker, R.; Buscaroli, A.; Buerge, D.; Cross, A.; Dickinson, D.; Enders, A.; Esteves, V. I.; Evangelou, M. W.; Fellet, G.; Kevin, F.; Gabriel, G.; Glaser, B.; Hanke, U. M.; Hanley, K.; Hilber I; Kalderis, D.; Leifeld, J.; Masek. O.; Mumme, J.; Carmona, M. P.; Pereira, R. C.; Rees, F.; Rombolà, A.; de la Rosa, J. M.; Sakrabani, R.; Sohi, S.; Soja, G.; Valagussa, M.; Verheijen, F.; Zehetner, F. (2016) Toward the Standardization of Biochar Analysis: The COST Action TD1107 Interlaboratory Comparison. Journal of Agricultural and Food Chemistry 64, 513−527.	*Bachmann Hans-Joerg*	*37*	*H. Knicker MCM Spain, H. Schmidt MCM Switzerland, D. Dickinson STSM, G. Fellet STSM, G. Gasco MCM Spain, B. Glaser MCM Germany, U. Hanke STSM Germany, D. Kalderis MCM Greece, J. Leifeld MCM Switzerland, O. Masek WGM UK, Jan Mumme WGM Germany, F. Rees STSM France, R. Sakrabani MCM UK, S. Sohi, MCM UK, G. Soja MCM Austria, F. Verheijen MCM Portugal*	*1*	*19.10.2015*	*2016*	http://dx.doi.org/10.1021/acs.jafc.5b05055	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*2.912*
2	Luke Beesley, L.; Inneh, O. S.; Norton, G. J.; Moreno-Jimenez, E.; Pardo, T.; Clemente, R.; Dawson, J. J. C. (2014) Assessing the influence of compost and biochar amendments on the mobility and toxicity of metals and arsenic in a naturally contaminated mine soil. Environmental Pollution 186, 195-202	*Beesley Luke*	*7*	*L. Beesley STSM UK*	*2, 4*	*28.09.2013*	*2014*	http://dx.doi.org/10.1016/j.envpol.2013.11.026	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*4,143*
3	Brennan, A.; Moreno Jiménez, E.; Puschenreiter, M.; Alburquerque, J. A.; Switzer, C. (2014) Effects of biochar amendment on root traits and contaminant availability of maize plants in a copper and arsenic impacted soil. Plant and Soil 379, 351-360.	*Aoife Brennan*	*5*	*A. Brennan, STSM UK*	*2, 4*	*13.10.2013*	*2014*	*http://dx.doi.org/10.1007/s11104-014-2074-0*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*2,952*
4	Chakrabarti, S.; Dicke, C.; Kalderis, D.; Kern, J. (2015)	*Shumon Chakrabarti*	*4*	*D. Kalderis MCM*	*2, 4*	*26.10.2014*	*2015*	*http://dx.doi.org/10.1007/s11356-015-4491-x*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*2,828*

[1] MC Member (MCM)/ MC Substitute (MCS)/ MC Observer (MCO)/ WG Member (WGM)/ Training School Trainee/ STSM Recipient (STSM)/ Other Action Participant (OAP). NB: If not otherwise indicated co-authors are Other Action Participants

[2] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

[3] H2020 Societal Challenges are “Health, demographic change and wellbeing”; “Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy”; “Secure, clean and efficient energy”; “Smart, green and integrated transport”; “Climate action, environment, resource efficiency and raw materials”; “Europe in a changing world - inclusive, innovative and reflective societies”; “Secure societies - protecting freedom and security of Europe and its citizens”

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	Rice husks and their hydrochars cause unexpected stress response in the nematode Caenorhabditis elegans: reduced transcription of stress-related genes. Environmental Science and Pollution Research 22, 12092-12103			*Greece, J. Kern MCM Germany*											
5	Conte, P.; Hanke, U. M.; Marsala, V.; Cimò, G.; Alonzo, G.; Glaser, B. (2014) Mechanisms of Water Interaction with Pore Systems of Hydrochar and Pyrochar from Poplar Forestry Waste. Journal of Agricultural and Food Chemistry 62, 4917–4923.	*Conte Pellegrino*	*6*	*U. Hanke STSM Germany, G. Cimò STSM Italy, B. Glaser MCM Germany*	*1, 4*	*27.02.2014*	*2014*	*http://dx.doi.org/10.1021/jf5010034*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*2.912*
6	José M. De la Rosa, J. M.; Paneque, M.; Hilber, I.; Blum, F.; Knicker, H.; Bucheli, T.D. (2016) Assessment of polycyclic aromatic hydrocarbons in biochar and biochar-amended agricultural soil from Southern Spain. Journal of Soils and Sediments *16, 557-565*	*Jose Maria de la Rosa*	*6*	*J. M. de la Rosa STSM Spain, H. Knicker MCM Spain*	*1, 2, 4*	*26.05.2015*	*2016*	*http://dx.doi.org/10.1007/s11368-015-1250-z*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*2,139*
7	Kern J.; Tammeorg, P.; Shanskiy, M.; Sakrabani, R.; Knicker, H.; Kammann, C.; Tuhkanen, E.-M.; Smidt, G.; Pasad, M.; Kari, T.; Sohi, S.; Gascó, G.; Steiner, C.; Glaser, B. (2016) Synergistic use of peat and chared materials in growing media – an option to reduce the pressure on peatlands? Journal of Environmental Management and Landscape Management, submitted	*Juergen Kern*	*14*	*J. Kern MCM Germany, P. Tammeorg MCS Finland, R. Sakrabani MCM UK, H. Knicker MCM Spain, C. Kammann MCM Germany, S. Sohi MCM UK, G. Gasco MCM Spain, C. Steiner MCM Austria, B. Glaser MCM Germany*	*1, 2, 4*	*26.05.2015*	*2016*	*http://dx.doi.org/10.1007/s11368-015-1250-z*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*0,623*
8	Meyer, S.; Genesio, L.; Vogel, I.; Schmidt H.-P.; Soja, G.; Someus, E.; Shackley, S.; Verheijen, F.; Glaser, B. (2016) Biochar standardization and legislation harmonization Journal of Environmental Management and Landscape Management, submitted	*Sebastian Meyer*	*9*	*S. Meyer STSM Germany, H.-P. Schmidt MCM Switzerland, G. Soja MCM Austria, E. Someus MCM Hungary, S. Shackley MCM UK, F. Verheijen MCM Portugal, B. Glaser MCM Germany*	*4*	*31.05.2016*	*2016*	*TBA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*0,623*
9	Tammeorg, P.; Bastos, A. C.; Rees, F.; Kern, J.; Graber, E. R.; Ventura, M.; Kibblewhite, M.; Amaro, A.; Budai, A.; Cordovil, C.; Domene, X.; Gardi, C.; Gasco, G.; Horak, J.; Kammann, C.; Kondrlova, E.; Laird, D.; Loureiro, S.; Martins, M.; Panzacchi, P.; Prasad, M.; Prodana, M.; Peregrina Puga, M.; Ruysschaert, G.; Sas-Paszt, L.; Silva, F.; Teixeira, W.; Tonon, G.; Delle Vedove, G.; Zavalloni, C.; Glaser, B.; Verheijen, F. (2016) Biochars in soils: Towards the required level of scientific understanding. Journal of Environmental Management and Landscape Management, submitted	*Priit Tammeorg*	*33*	*P. Tammeorg MCS Finland, A. C. Bastos MCM Portugal, J. Kern MCM Germany, E. Graber MCM Israel, G. Gasco MCM Spain, J. Horak MCM*	*2, 4*	*31.05.2016*	*2016*	*TBA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*0,623*

				Slovakia, C. Kammann MCM Germany, E. Kondrlova MCM Slovakia, G. Ruysschaert MCM Belgium, L. Sas-Paszt MCM Poland, G. Tonon MCM Italy, C. Zavalloni MCM Italy, B. Glaser MCM Germany, F. Verheijen MCM Portugal											
10	Verheijen, F.; Manakasingh, U.; Penizek, V.; Panzacchi, P.; Glaser, B.; Jeffrey, S.; Bastos, A. C.; Harter, J.; Kern, J.; Zavalloni, C.; Zanchettin, G.; Sakrabani, R. (2016) Representativity of European Biochar Research: Part I Field trials: Journal of Environmental Management and Landscape Management, in preparation	*Frank Verheijen*	*12*	*F. Verheijen MCM Portugal, U. Manakasingh MCM Island, B. Glaser MCM Germany, S. Jeffrey MCM Netherlands, A. C. Bastos MCM Portugal, J. Harter STSM Germany, J. Kern MCM Germany, C. Zavalloni MCM Italy, R. Sakrabani MCM UK*	*2, 4*	*31.05.2016*	*2016*	*TBA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*0,623*

FP7/ H2020 Proposals and projects

This table contains FP7/ H2020 proposals/ projects spinning off from Action activities and including in the proposing consortium at least three Action participants from at least three different countries participating in the Action.

NO.	Title	Name and country of main proposer	Number of proposers	Action participants listed among the proposers (Name, country, role[3] in the Action)	Funding agency submitted to	Date submitted	Date results expected	Result	Call identifier	Relevance to H2020 Societal Challenges[4]?	Was the added value of the Action Networking necessary for the proposal / project?
Projects											
1											
Proposals											
	Design and demonstration of circular value and supply chains of recovered bio-NPK (NUTRI-CIRC)	Edward Someus, Hungary	15	E. Someus MCM Hungary, B. Glaser MCM Germany	Horizon2020	08.03.2016	Autumn 2016	TBA	H2020-CIRC-2016TwoStage	Yes	Yes
	Agricultural Waste for Green Carbon Products (AgriCarb)	James Clark, UK	21	A. Zabaniotou MCM Greece, B. Glaser MCM Germany, P. Pitk MCM Estonia, L. Sas-Paszt MCM Poland, G. Dunst MCM Austria	Horizon2020	07.09.2015		9/15 (second stage)	H2020-WASTE-2015-two-stage	Yes	Yes

	Agriculture and livestock waste sustainable management Network (ALWasteNet)	Maria A. Rao, Italy	30	H. Knicker MCM Spain, B. Glaser MCM Germany	Horizon2020	07.09.2015		10.5/15 (second stage)	H2020-WASTE-2015-two-stage	Yes	Yes

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I.C. Networking

Added value of the Networking			
Establishment of European Biochar Research Network. Frequent trans- and interdisciplinary meetings among European biochar researchers and across European countries. Meetings of biochar researchers and stakeholders. Pan-European evaluation of available biochar pot and field experiments. Contribution to biochar harmonization and legislation.			
The table below shows the extent to which it would have been possible to achieve each of the Action's objectives without the Action networking.			
MoU objective	Possibility of achievement without Action networking		
	Fully	Partially	Impossible
Systematize essential knowledge to optimize Biochar production ("designer Biochars") with regard to its properties and effects, considering the large range of suitable biomass, energy and mass balances, cost efficiency and Biochar quality		X	
Develop an EU road map to produce 140 million tons of Biochar annually by processing 500 million tons of organic residues, offsetting 10% of the European fossil fuel use			X
Systematize and integrate knowledge to identify the most beneficial Biochar use strategies in agriculture across various European regions and climates, identifying the most promising applications		X	
Identify a comprehensive strategy for the most efficient use of Biochar to maintain and improve C sequestration and soil fertility		X	
Evaluate potential threats accompanying the use of Biochar in soils. According to the European Community Regulation on chemicals and their safe use (REACH), safety information on Biochar will deal with toxic compounds (i.e. PAHs, heavy metals) and their effects on plant, animal and human health (e.g. genotoxicity) and effects on GHG emissions (i.e. N2O, CH4, CO2)		X	
Evaluate potential benefits in detoxification strategies where Biochar is used to adsorb organic pollutants or heavy metals in soils or animal feed		X	
Systematize current risks vs. benefits understanding to put forward "best practice" recommendations in preparation for legislation requirements			X
Provide target group-specific recommendations on how to use the knowledge provided about Biochar efficiently			X
Promote public information transfer to enable use of state-of-the art knowledge			X
Extent of the networking			
In total, eBRN covered more than 300 participants. All of them were equally integrated into the eBRN. However, there were of course more active members than other ones. Those targeted by COST policies on Inclusiveness Target Countries (ITCs), Early Career Investigators (ECIs)/ Young Researchers, and gender balance were fully integrated into the Action networking.			

I.D. Impacts

The impacts that have resulted, or might result from the Action are described in the following table.

Description of the impact	Type of impact[4]	Timing of impact[5]
Biochar being part of European Fertilizer Directive (annex A)	Societal	Achieved
European Biochar standard (European Biochar Certificate)	Economical	Achieved
Evaluation of biochar effects in soil across Europe	Scientific	Achieved
Awareness of biochar in society	Societal	Achieved

[4] Scientific/ technological, Economic, Societal
[5] Achieved/ Foreseen within 2 years/ Foreseen 2-5 years/ Foreseen 5-10 years/ Foreseen 10+ years

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I.E Dissemination and exploitation of Action results

Describe the Action's dissemination and exploitation approach as well as all activities undertaken to ensure dissemination and exploitation of Action results and the effectiveness of these activities.			
Biochar COST Action results have been published at the eBRN website as well as in peer-reviewed scientific journals. Furthermore, scientific and technological results have been presented to a broader audience during numerous biochar conferences, workshops, and training schools			
Item/ activity	Target audience	Result	Hyperlink
eBRN website	All people interested in biochar	Website	http://cost.european-biochar.org/en
Biochar ring trial	Scientists	Peer-reviewed publication	http://dx.doi.org/10.1021/acs.jafc.5b05055
Training schools	Young scientists	Training	http://cost.european-biochar.org/en
Workshops	Scientists and stakeholders	Publications	See publication part
Conferences	Scientists, stakeholders, general public	Publications	http://cost.european-biochar.org/en
Publications	Scientists and stakeholders	Publications	See publication list

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I.F Action success(es)

COST regularly communicates the successes of Actions. What aspect(s) (outcomes and/ or impacts, rather than activities) of this Action is/ are the most suitable for communication?

Description of the success story	Dimension of the success ■ Breakthrough: scientific, technological or socioeconomic ■ Policy implementation (specify which policy) ■ Capacity building
Biochar being part of the new EU Fertilizer Directive	Policy implementation
Training of a huge number of young scientists	Capacity building
Publication of overarching scientific papers	Scientific breakthrough

II. Management Report

II.A. Overview of expenditure

The table below summarises the Action's expenditure throughout its four year life.

	Grant Period 1	Grant Period 2	Grant Period 3	Grant Period 4	TOTAL
GP start and end dates	(01/07/2012-30/06/2013)	(01/07/2013-30/06/2014)	(01/07/2014-30/06/2015)	(01/07/2015-25/03/2016)	
Grant Holder institution	Martin Luther University Halle-Wittenberg (DE)	Martin Luther University Halle-Wittenberg (DE)	Martin Luther University Halle-Wittenberg (DE)	Martin Luther University Halle-Wittenberg (DE)	
Meetings	EUR 68.418,51	EUR 81.896,19	EUR 90.719,30	EUR 54.385,69	EUR 295.419,69
Training Schools	EUR 12.560,84	EUR 24.339,46	EUR 21.744,15	EUR 20.766,20	EUR 79.410,65
STSMs	EUR 12.000,00	EUR 7.163,00	EUR 17.500,00	EUR 20.450,00	EUR 57.113,00
Dissemination	EUR 8.783,15	EUR -	EUR 2.552,62	EUR 12.312,00	EUR 23.647,77
OERSA[1]	EUR -	EUR -	EUR -	EUR -	EUR -
Total Scientific Expenditure	EUR 101.762,50	EUR 113.398,65	EUR 132.516,07	EUR 107.913,89	EUR 455.591,11
FSAC[2]	EUR 15.229,98	EUR 16.239,00	EUR 19.877,03	EUR 16.187,08	EUR 67.533,09
TOTAL	EUR 116.992,48	EUR 129.637,65	EUR 152.393,10	EUR 124.100,97	EUR 523.124,20

[1] OERSA = Other Expenses Related to Scientific Expenditure (e.g. bank charges)
[2] FSAC = Amount received by Grant Holder for Financial Scientific and Administrative Coordination

II.B. Budget and Participation management

II.B.1 Budget spent in relation to individuals/ institutions outside participating COST countries					
STSMs from or to institutions from countries other than Participating COST countries					
The table below describes the added value STSMs to approved institutions in IPC or NNC or Specific Organisations and any STSMs from an approved institution in an NNC to a participating COST country.					
Grantee		Host		Date	Topic and value added to the Action
Institution	Country	Institution	Country		

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Add home institution and country	Add host institution and country	Date	Describe topic of the STSM and the added value to the Action

Invited Speakers

The table below highlights the added value of Invited Speakers from COST countries that have not accepted the MoU and/ or non-participating NNC, IPC or Specific Organisations whose participation at a meeting or Training School was reimbursed by the Action.

Participant name	Institution	Country	Event date	Topic and added value to the Action
Mai Thi Lan Anh	Add	Vietnam	24.06.2015	Biochar use in tropical countries
Nancy Karanja	Add	Kenia	24.06.2015	Biochar use in tropical countries
Mohamad Amran Bin Mohd Salleh	Add	MY	24.06.2015	Biochar use in tropical countries
Edward Yeboah		Ghana	24.06.2015	Biochar use in tropical countries
Johannes Lehmann		USA	28.09.2015	Keynote speaker final conference

Dissemination meetings

The table below highlights the added value of Dissemination Meetings financed from Action funds.

Participant name	Role	Country	Date	Location	Topic and added value to the Action
Not applicable					

II.C. Participants

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Annex 1

Definitions:

COST Action Challenge (main aim)	"The research question addressed by the COST Action targeting scientific, technological, and / or socioeconomic problems"
COST Action Innovation	"The creation and / or development of new or improved concepts, products, processes, services, and / or technologies that are made available to markets, governments and society"
COST Action objectives	"COST Action objectives are the results that an Action needs to achieve in order to respond to meet its challenge. These are SMART (Specific, Measurable, Achievable, Relevant, Timely) and twofold: research coordination objectives and capacity building objectives."
COST Action research coordination objectives	"Achieving these objectives turns COST Actions from initially scattered teams into one transnational team and leverages the existing funded research. These objectives entail the distribution of tasks, sharing of knowledge and know-how, and the creation of synergies among Action participants to achieve specific outputs."
COST Action capacity building objectives	"Achieving these objectives entail building critical mass to drive scientific progress, thereby strengthening the European Research Area. They can be achieved by the delivery of specific outputs and / or through network features or types and levels of participation."
COST Action networking activities	"any activities organised by the COST Action (whether or not directly funded by COST) in order to achieve research coordination and capacity building objectives."
COST Action networking tools	"instruments through which eligible activities can be funded"
COST Action outputs	"direct results from the COST Action activities. These can be codified knowledge, tacit knowledge, technology, and societal applications."
COST Action impact	"the short- to long-term scientific, technological, and / or socioeconomic changes produced by a COST Action, directly or indirectly, intended or unintended."
COST Action deliverable	"a distinct, expected and tangible output of the Action, meaningful in terms of the Action's overall objectives such as a report, a document, a technical diagram, a software etc. Action deliverables are used to measure its progress and success."
COST Action milestones	"Control points in the Action that help to chart progress. They are also needed at intermediary points so that, if problems have arisen, corrective measures can be taken. A milestone may be a critical decision point in the Action where, for example, the MC must decide which of several technologies to adopt for further development (e.g. core group and MC meetings, mid-term reviews)"
Inclusiveness Target Country (ITC):	Current COST Member Countries targeted by the COST inclusiveness Policy ("Inclusiveness Target Countries" (ITC)): EU 13 (Bulgaria, Cyprus, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovenia, Slovakia), EU candidate countries (the former Yugoslav Republic of Macedonia, Montenegro, Republic of Serbia, Turkey) and potential EU candidate countries (Bosnia and Herzegovina). In addition, to comply with the EC criteria for 'Spreading Excellence and Widening Participation', Portugal and Luxemburg are included.

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