

Edward Someus

Zero emission recycling processing technology for knowledge based bioeconomy, ecological and economical organic by-product valorization.

3R – Recycle – Reduce – Reuse


Zero emission pyrolysis carbon refinery and Phosphorus recovery, **+35 years of biochar history and progressive evolution with market driven science/technology results: 1983 - 2019**



Made in Europe

In a world with finite resources there is no infinite development opportunity with sustainability, unless resource efficient circular economy is fully implemented.

BACKGROUND:

- | | |
|---|---|
| 1972-1979 | Edward Someus: University of Lund, Sweden (Natural and Earth sciences, graduated in 1978, M.Sc., (Natural & Environmental Science). |
| 1980 - 2018 | Edward Someus carrier: environmental engineering, biochar science & technology senior engineering |
| 1983 | The 3R technology idea: horizontally arranged indirectly heated systems (new generation of indirectly heated rotary kiln for high temperature carbonization of organics, carbon activation and bone char processing (CAS 8021-99-6). |
| 1983 | The 3R technology idea: horizontally arranged indirectly heated systems (new generation of indirectly heated rotary kiln for high temperature carbonization of organics, carbon activation and bone char processing (CAS 8021-99-6). |
| 1983-1986  | TRL4 Technology Readiness Level: technology validated in lab. First generation lab unit of the 3R. Pre evaluation: scientifically research, laboratory bench tests. Evaluation of the concept and the competitor state-of-the-art, evaluation of patents, initial market research for future full scale application feasibility. |

THE 3R DEVELOPMENT time line

1989 



TRL5 Technology Readiness Level: technology validated in industrially relevant environment. Second generation pilot plant scale up unit of the 3R. Pilot Plant engineering concept design (LangCarbon Ltd. – est. 1989 - a joint venture with Lang Machine Works (established in 1875, now Alstrom Power Corp. subsidiary). New name of the Lang Carbon Ltd. is Terra Humana Clean Technology Development, Engineering and Manufacturing Ltd.). RTD and innovative development concept: develop, design, build & operate economically attractive and ecological sustainable organic waste high added value zero emission processing industrial system, but use no exotic design/materials.

1988-1990

Industrial application feasibility study and concept pre design

1989-1990

Manufacturing of Pilot Plant novel components, such as the indirectly heated rotary kiln of 0,5 m³/h continuous capacity and the off-gas treatment.

1990-1995

TRL5 PILOT - RESEARCH PLANT TESTS - FIRST RESULTS: confirmed proof of evidence for main components for the technical and economical efficiency of the construction, focused on test of 3R technology specific design elements: (1)indirect heat transfer, (2)achieved very high material core temperature 750 °C in carbonization phase, (3)separation of carbon – gas-vapour phase, (4)sealing and air tight construction, (5)continuous input and output, (6)flexible operation mode, (7)high operational safety (8)high carbonization efficiency and high end product quality (BET 600 – 1100 m²/g).

1994-2001

Full scale detailed engineering design and work out of alternative industrial applications (detailed engineering design for 0,8 m³/h throughput and pre design concept for scale up installations).

1999-2003

Process method and industrialized full scale technology engineering design development of ABC animal bone biochar integrated solid state fermentation and formulation biotechnology.

2002-2005 

TRL6 Technology Readiness Level: technology demonstrated in industrially relevant environment. IRL6 Investment Readiness Level: validate revenue model. Third generation field demonstration industrial plant scale up unit of the 3R. **The European Union High Commission priority selection of the 3R technology: EU FP5 NNE5/363/2001 Clean Coal project is EU contracted for specific energy application of combined**

brown coal and biomass “towards zero emission” programme (August 1, 2002 trough 2005, total cost € 2,25 million). 2004: EU compatible Authority permitting of industrial operations for the 3R installation in West Hungary (Polgardi). The industrial plant meets the requirements of the US EPA U.S. RCRA Miscellaneous Units 40 CFR 264 Subpart X as well.

2004 **Finalization of the comprehensive <0.8 m³/h feed capacity 3R carbonization industrial FIELD DEMONSTRATION and production plant’s erection for wide feed flexibility Clean Coal energetic material industrial treatability study applications and commercial production of refined carbons.**

2005 **Successful execution of Clean Coal pilot testing** (industrial scale coal and biomass throughput). Development of pre design concept for conversion of raw pyrolysis gas-vapor to syngas and conversion of raw pyrolysis oil to transport quality fuel oil.

Field Demo tests



2004-2018 – successfully proven and demonstrated industrial tests in Hungary for different types of agricultural, food industrial (animal bone meal and bone chip), organic waste (MSW derived fraction, scrap tyre rubber crumb) and brown coal treated to test and demo. Field demo tastings of the ABC Animal Bone bioChar products in Italy, Germany, The Netherlands, Israel, Denmark, Hungary under different climatic and soil conditions.








TRL 7 Technology Readiness Level: system prototype demonstration in operational environment. IRL7 Investment Readiness Level: prototype fidelity investment viable product. The business and application oriented scientific RTD project EU FP6 514082 PROTECTOR is EU contracted (12 partners from 8 countries). The low input farming RTD and demonstration project is aiming to develop biocontrol agents against soil borne plant pathogens in the vegetable cultivations and provide natural plant nutrition with recovered Phosphorus. Duration:42 months, total cost € 2,63 million.

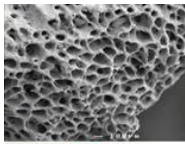
2005 Completion of the final scientific and technical report submission for successfully completed NNE5/363/2001 EUFP5 project.

2005 First European biochar Authority permit start up.

2006 February **The EU Commission DG Transport and Energy accepts final scientific - technical report for NNE5/363/2001 and congratulates for the results.**

- 2006 ISO 9001 and ISO 14001 certified for agro biotechnology.
- 2007 - 2012 PROTECTOR field testing in different climatic and soil conditions (IT, NL, DE, IL, HU)
- 2008-2009  Intelligent Energy Europe **BIOPROFARM** EIE-05-086: Promotion of Biomethanisation in Agricultural Environment as a Decentralised Renewable Energy Resource for Europe EU contracted.
- 2008-2012  **EU FP7 EUPHOROS 211457:** Reducing the need for external inputs in high value protected horticultural and ornamental crops is EU contracted.
- 2009 **The EU Commission accepts final scientific and technical report for PROTECTOR FOOD-2005-514082. Success story: EU-Agrinet publication.**
- 2009-2012 GOP-1.1.1-08/1-2008-0010: development of method and catalyst materials for conversion of pyrolysis gas to syngas.
- 2009 - 2015 BIOCHAR AUTHORITY PERMIT 02.5/67/7/2009: Formulated 3R-AGROCARBON microbiological substance EU product permit application for open soil and green/glass house organic, low input and conventional cultivation.
BIOCHAR AUTHORITY PERMIT CLP APPROVAL: 04.2/102-2/2015
- 2009-2012  **EU-CIP-ECOINNOVATION:** large scale industrial application and market replication of Agrocarbon bio-technology is EU contracted. (2009-2012).
- 2011-2016  **TRL 8 Technology Readiness Level: system complete and qualified. IRL8 Investment Readiness Level: validate value delivery. EUFP7 REFERTIL 289785:** Reducing mineral fertilizers and chemicals use in agriculture by treated compost and biochar. Improvement of comprehensive bio-waste transformation and nutrient recovery treatment processes for production of combined natural products and recovered Phosphorus. EU policy support to the Commission for the law harmonization of the biochar and compost cases. Development of new compost and biochar standards in the EU27 for EU law harmonization. (project value €4.2 M).
- 

2013-2018 



ABC
Animal Bone
bioChar

System engineering completed and qualified (Technology Readiness Level TRL8), full industrial scale engineered and designed for commercial operational environment (TRL9 ~20,800 t/y 2.6 t/h) throughput industrial capacity, 3R and ABC Animal Bone bioChar processing engineering design is completed.

Fourth generation commercial industrial plant unit design of the 3R completed 2018 end and ready for industrial production implementation.

Final report submitted to the EU Commission. **The international EU cooperative research and innovation development phase 2002-2015 under EU Commission programmes and the technology industrialization development since 1989 is successfully completed.** Conversion of biochar science into legalized industrial practice is fully prepared.

>2018 

Establishment of **3R industrial replication franchise model BAT/BREF concept (REPLICATOR) for utilization and exploitation of the results;** key enabling technological achievements and actual system proven in operational environment. The project will include full industrial, technical, legal (EU permits) demonstration and biochar products competitive market introduction -commercialization as well. Parallel activities: biochar training and education from application oriented SME farmer through high scientific levels. Location: EU Member State is under selection.

TRL9. Competitive manufacturing in full industrial scale in a selected EU MS (industrial replication franchise model). **TRL9 Investment Readiness Level: identify and validate metrics that matter.** Implementation of the 3R industrial replication franchise model system with 20,800 t/y throughput capacity and market build up. Operations in the EU, Australia and the USA.

2019 – 2020
MARKET
CAPITALIZATION

Implementation of the full industrial REPLICATOR with 20,800 t/y throughput capacity and sales plan over €15 million/year from 2021. Extensive market valorization and market capitalization of the 3R Zero Emission Pyrolysis technology and Bio-Phosphate products to reach immense market and economic values in the EU, USA and Australia.

2021-2025

Ten replicated full industrial projects in several EU countries, USA and Australia with business objective to exceed >€100million scale.

SCIENCE to ACHIEVE DEMONSTRATED RESULTS

Acknowledgement: I am using this opportunity to express my gratitude to the European Commission and all Partners who supported me throughout the course of the 3R pyrolysis technology and biochar product development project since 2002. **The 3R development has been built up step by step from TRL1-TRL9, whereas these key important projects have been the coherent and integrated building stones of the past decade**, which systematic efforts resulted a fully matured and comprehensive solution for „**science to achieve results**” by 2019.

- 1) The **NUTRIMAN** project is co-funded by the European Union, Seventh Framework Programme under Grant Agreement number 818470, 2018-2021.
- 2) The **REFERTIL** project is co-funded by the European Union, Seventh Framework Programme under Grant Agreement number 289785, 2011-2016.
- 3) The **PROTECTOR** project is co-funded by the European Union, CIP Eco-innovation under Grant Agreement number ECO/08/238984/SI2.532247, 2009-2012.
- 4) The EU FP7 **EUPHOROS** project is co-funded by the European Union, Seventh Framework Programme, under Grant Agreement number 211457, 2009-2012.
- 5) The EU FP6 **PROTECTOR** project is co-funded by the European Union, Sixth Framework Programme under Grant Agreement number 514082, 2005-2009.
- 6) The EU FP5 **MULTI FUEL** project is co-funded by the European Union, Fifth Framework Programme under Grant Agreement number NNE5/363/2001, 2002-2005.

3R CARBON RELATED WORK FIELDS:

- **Carbon Recycling and Refining**, thermal processing by zero emission carbonization for recycling of carbon for wide range of natural and carbon negative product applications.
- **Phosphorus recovery**.
- **Carbon Bio-formulation**, biotech formulation of carbon for efficient bio and plant availability of nutrient uptake process support. SSFF solid state fermentation/formulation.
- **Carbon Bio-energy**, chemical processing of pyrolysis gas-vapors and bio-oils for syngas and bio-energy production and other added value products.

3R TECHNOLOGY MAIN ELEMENTS:

- **CARBONIFEROUS MATERIALS-to-REFINED CARBONS:** carbonization process (main technology), indirectly heated horizontally arranged rotary kiln vacuum pyrolysis.
- **CARBON BIO-CARRIERS:** solid state fermentation and formulation, biotech process, where specific and biotech adaptable carbon is used as solid carrier for soil microorganism for purpose of accelerated and plant available mineral dissolution, develop controlled microbiological environment in soils with effects of plant growth promotion and biocontrol by effects. Objective: safer food production for less cost.
- **CARBON-to-LIQUID FUEL (biomass-to-liquid fuel):** catalytic conversion of raw pyrolysis gases/oil liquids to high grade liquid bio-fuels and other added value products/organic chemicals.

3R APPLICATIONS:

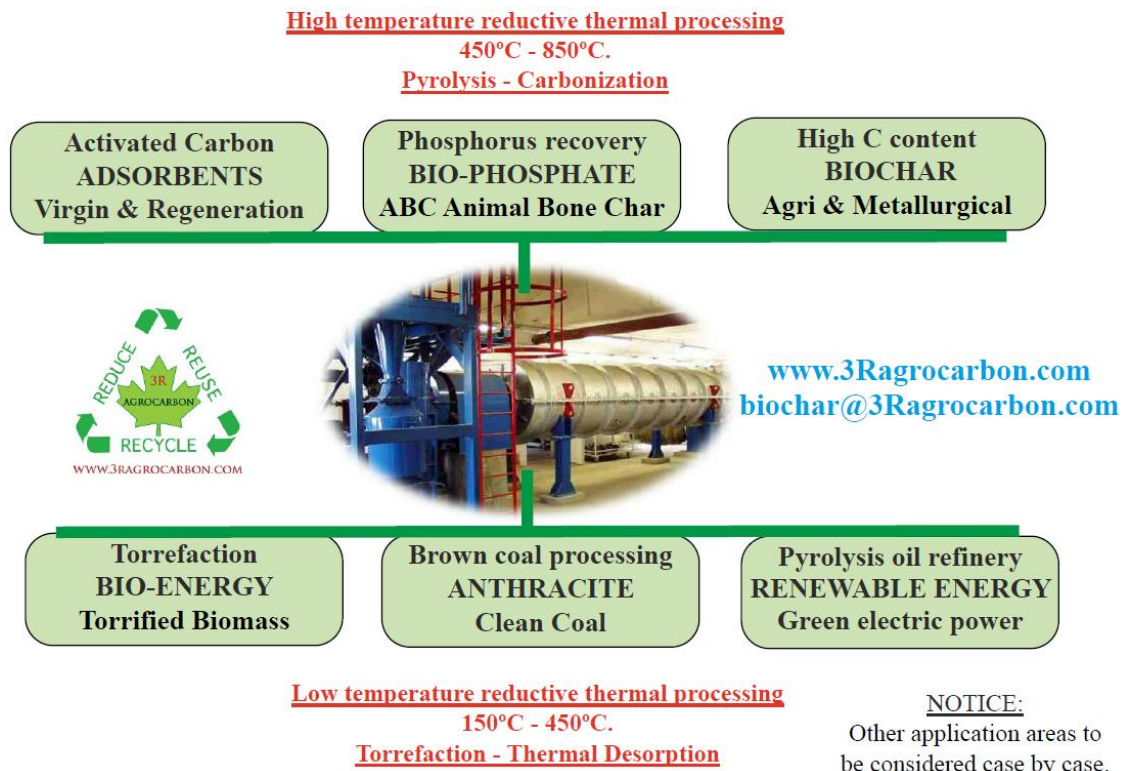
- **Agriculture - horticulture:** plant and/or food grade animal bone (category 3, 2) based biomass refinery conversion, biochar, bone char; fully natural bio-NPK-C fertilization organic P fertilizer (**ABC Animal Bone bioChar**) for food crop productions with biocontrol and plant growth promotion effects, and strong support of drought and salt tolerance food crop/forest cultivations.
- **Energy Biomass:** plant and/or animal MBM/PAP organic waste to solid (bio-carbon) and liquid (steam reformed producer gas, bone oil (Dippel's Oil), bio oil, thermal energy).
- **Energy Clean Coal:** large industrial scale conversion and valorisation of brown coal into clean coal and liquid fuel kerosene. Conversion and valorisation of scrap tire rubber crumb into liquid fuel and secondary carbon black.
- **Adsorbent:** ABC bone char adsorbents for very high efficient treatment of macromolecular organic contaminations, heavy metal and radionuclide contaminations.
- Other applications are for cases by case considerations.
- **IPR Intellectual property rights**

Sole inventor and sole owner is Edward Someus.

The 3R is developed and industrial designed by Edward Someus.

The 3R original solution is protected by confidential industrial designs and know-how.

"3R" zero emission carbon refinery technology application map 2019 for flexible reductive thermal processing in any range up to <850°C material core temperature.



Publications:

E. Someus, M. Pugliese: **Concentrated Phosphorus Recovery from Food Grade Animal Bones** <http://www.mdpi.com/2071-1050/10/7/2349>

E. Someus, **Food crop mineral deficiency and disturbance stress mitigation in temperate climatic regions by economical and environmental valorization of agricultural by-products**, Nova Science, New York, 2009.

Web: https://www.novapublishers.com/catalog/product_info.php?products_id=8372

G. P. Warren, J.S.Robinson and E. Someus, **Dissolution of phosphorus from animal bone char in 12 soils**, Nutrient Cycling in Agroecosystems, Volume 84, Number 2/ Jun, 2009, Springer Netherlands. <http://www.springerlink.com/content/4876u47123372264/>

J. Postma, E.H. Nijhuisa, E. Someus, **Selection of phosphorus solubilizing bacteria with biocontrol potential for growth in phosphorus rich animal bone charcoal**, Applied Soil Ecology 46 (2010) 464–469, August 2010, www.elsevier.com/locate/apsoil.

J. Postma, F. Clematis, E. H. Nijhuis, E. Someus, **Efficacy of four phosphate-mobilizing bacteria applied with an animal bone charcoal formulation in controlling Pythium aphanidermatum and Fusarium oxysporum f.sp. radicles lycopersici in tomato**, Elsevier, Biological Control 67 (2013) 284–291, 19 July 2013, www.elsevier.com/locate/ybcon

J Postma, E Nijhuis, F Clematis, E Someus, **“Recycling and upgrading of bone meal for environmentally friendly crop protection and phosphate fertilization”**ORBIT Conference, October 13-15, 2008, Moving Organic Waste Recycling Towards Resource Management and for the Biobased Economy, Wageningen, The Netherlands. Wageningen University Research, Plant Research International B.V, P.O. Building nr. 107, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands <http://www.orbit2008.de>

European Union CORDIS database: **EU FP5 NN5/363/2001 MULTI FUEL** “Multi Fuel Operated Integrated Clean Energy Process: Thermal Desorption Recycle-Reduce-Reuse Technology” 2002-2005 (coordinator and key technology designer) <http://cordis.europa.eu/>

European Union CORDIS database: **Food-2005-514082 PROTECTOR** “Recycling and upgrading of bone meal for environmentally friendly crop protection and nutrition” 2005-2008 (coordinator and key technology designer) <http://cordis.europa.eu/>

Someus, **“3R biotechnology integrated industrialized biochar production”**2008 Conference of the International Biochar Initiative, BIOCHAR, SUSTAINABILITY AND SECURITY IN A CHANGING CLIMATE, Newcastle, United Kingdom, September 8-10, 2008, www.biochar-international.org

C Baum, P Leinweber, K Eckhardt, E Someus, M Halasz, **“Auswirkungen der Applikation von mit Trichoderma harzianum inokulierter Knochenkohle auf die mikrobielle Biomasse, Enzymaktivitäten und die Zusammensetzung der organischen Substanz des Bodens (Effects of the application of animal bone charcoal inoculated with Trichoderma harzianum**

on the soil microbial biomass, enzyme activities and the composition of soil organic matter), German Community of Soil Science Conference in Osnabrueck, February 25, 2008,

J. Postma, E. Nijhuis, F. Clematis, E. Someus “**A new carrier for biocontrol agents**”, Wageningen University Research, Plant Research International B.V, P.O. Building nr. 107, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands.

J. Kruse, P. Leinweber, F. Godlinski, E. Someus, “**Speciation and quantification of inorganic and organic P forms in environmental samples by P L-edge XANES**” University of Rostock, Germany, Agriculture & Agrifood Canada, Lethbridge Research Station.

E. Someus, “**TOWARDS ZERO EMISSION: Economical Conversion of Low-grade Coal to Clean Coal by Low Temperature Carbonization Pretreatment Process**” Twenty-seventh Annual International Conference on Thermal Treatment Technologies; May 12-16, 2008, Montreal, Quebec, Canada, Air & Waste Management Association, USA, University of Maryland, USA, United States Department of Energy. www.awma.org/.

M Polgari, J Hein, M Toth, A Brukner-Wein, T Vigh, E Someus, M Halasz, L Biro, “**Genesis of a regionally extensive celadonitic chert/ironstone bed overlying Upper Lias Manganese deposits**” (SED-2007-OM-176), Sedimentology, International Association of Sedimentologists.

E Someus, “**Plant derived feed additive: recent scientific results and regulatory development, successful EU projects and partners for scientific cooperation**” FEED –SEG Symposium, January 14-15, 2008, Hungary, <http://www.matchmaking.at/feedseg/>

E Someus, “**Moving Towards Zero-Emission Plants**” June 20-22, 2005, Leptokarya Pieria Greece

International Symposium, <http://www.lignite.gr>, <http://www.lignite.gr/mt0ep/mt0ep.htm>

E Someus, **The 3R Anthracite Clean Coal Technology**, CARBO 2/2006, Poland

E Someus, **The 3R ANTHRACITE CLEAN COAL TECHNOLOGY. Economical Conversion of Browncoal to Anthracite Type Clean Coal by Low Temperature Carbonization Pre-Treatment Process**, Original scientific paper, UDC: 662.641.66:662.612, BIBLIO: 0354-9836, 10 (2006), 3, 55-69. THERMAL SCIENCE:Vol. 10. (2006) No.3, pp.55-69.

Caroline De Smedt, Edward Someus, Pieter Spanoghe, **Potential and actual uses of zeolites in crop protection**, Pest Management Science 02/2015; DOI:10.1002/ps.3999

Ferenc Lónyi, József Valyon, Edward Someus, Jenő Hancsók, **Steam reforming of bio-oil from pyrolysis of MBM over particulate and monolith supported Ni/γ-Al₂O₃ catalyst**, Fuel 10/2013; 112:23–30. DOI:10.1016/j.fuel.2013.05.010

Making green organic fertilisers from bones, 2015 EU COMMISSION H2020: <http://ec.europa.eu/programmes/horizon2020/en/news/making-green-organic-fertiliser-bones>