



3R-BioPhosphate Ltd.

Established 1989 as Swedish-Hungarian joint venture (HU10254073),
Lang Machine works (since 1870, ALSTOM subsidy)

Industrial site & laboratory: H-2472 Kajaszo, Biofarm Road 58/3, **Biofarm Agri Research Station**, Hungary (M7 highway West 33 km, Google maps <https://goo.gl/maps/wHxmZ7J1ChJ2>)

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General manager, owner & key tech designer: Edward Someus (biochar S&T senior engineer)

The 3R (Recycle-Recover-Reuse) is a technology-intensive company playing a leading international role in commercial up-cycling of agricultural and food industrial by-products by unique zero emission pyrolysis and other advanced/innovative integrated technologies for high added value material recovery in economical industrial scale and performance.

CORE COMPETENCES:

- Circular economical nutrient recovery for organic and low input farming applications;
- Phosphorus recovery technologies and products, P reuse applications, LCA and CBA, market evaluations in the EU, USA and Australia;
- 3R zero emission pyrolysis technology and recovered nutrients combined formulations, incl. all elements from science into full industrialization value chain under market competitive conditions;
- EU policy knowledge and policy support, including Circular Economy, Green Deal, Fertilising Products Regulation 1009/2019, EU Critical Raw Materials, REACH and Authority permitting of processing technologies & bio-based products.
- Standardization and EU law harmonization of innovative fertilizer products in economically important European dimensions.

3R-BioPhosphate Ltd. "3R" (former name Terra Humana Ltd.) is a science & technology intensive company with core competence of applied scientific RTD and industrial engineering of circular economical nutrient recycling and reuse from unexploited agricultural and food industry by-product streams, most importantly Phosphorus recovery. The applied technology is the innovative 3R zero emission pyrolysis technology and combined biotechnological formulations, incl. full

production and product application value chain RTD, industrial engineering, scale up and full industrial/market valorisation. BioPhosphate MS Authority permit: 6300/24071-1/2020.

The company was established as a Swedish-Hungarian joint venture in 1989 (ALSTOM Power subsidy) and became an independent company in 2001. Since 2002 3R-BioPhosphate Ltd. has coordinated multiple international research and development programs in the specific field of carbon refinery and Phosphorus recovery.

3R is the original source and inventor of “3R” Recycle-Reduce-Reuse zero emission advanced pyrolysis technology. The 3R development has been financed by the company until 2002. From 2002 the European Commission selected the technology and co-funded the further developments through large scale EU research and development programmes.

Based on the 2002-2019 extensive applied research activity in ten EU Member States with large number of academic and industrial partners, by late 2019 high “TRL” Technology Readiness Level with high research-maturity reached and significant progress made towards market uptake. The flagship project of the company is recovering Phosphorus (BIO-PHOSHATE) recycled natural organic fertilizers and its BIO-NPK-C formulations made from agricultural and food industrial by-products for organic and low input farming applications.

During the past years 3R has built up a wide network of stakeholders both in scientific and industrial sectors. The owner and managing director of the company is Mr. Edward Someus, a senior Swedish S&T environmental engineer with core competence and specialization on industrial pyrolysis, carbon product development, Phosphorus recovery from animal by-products and marketing of such products in the agricultural and environmental industrial sectors as adsorbent. Mr. Someus is also involved in European Commission standardization and law harmonization as a consultant for revision of the EU Fertiliser Regulation in the area of Phosphorus, biochar, struvite and ash products for the use of innovative fertilisers.

3R-BioPhosphate Ltd has been established in 1989, as Swedish-Hungarian joint venture between the Swedish environmental engineer Edward Someus and Lang Machine Works (**since 1868** as Central Europe's largest industrial boiler and carbon processing manufacturing organization (now ALSTOM Power). 3R-BioPhosphate Ltd. has been independent SME organization since year 2001. The company **mission is to develop, engineering design and manufacture of novel bio-waste and biochar based technologies** and organic waste treatment systems on a EU level for advanced bio-char processing by pyrolysis and biotech means for the industry and agriculture.

The flagship project of the company is recovering phosphorus and other nutrients from bio-waste by pyrolysis technology; biochar biotechnological formulation. 3R-BioPhosphate Ltd. is the only one biochar vendor in Europe, with specific technology and accredited Authority permit under the united EU and Member State regulation to use qualified and eco-safe ABC-BioPhosphate product in open ecological soil environment (permit number 6300/2401-1/2020). During the past two decades the company put in huge human and financial efforts to develop innovative eco-industrial advanced solutions, design, implement and tests “product like” field plants to meet **SME specific market demands** in the EU, Canada, USA, Australia and Japan.

Extensive scientific and SME industrial networks developed in 10 EU countries and in Australia with large number of RTD partners, Universities, large institutions, SME users, farmers and large industrial organizations. The SME Company is having advanced and well equipped research, laboratory and field test facilities in W Hungary at the BIOFARM and extensive SME cooperation on international level.

The 3R pyrolysis field demonstration equipment has been successfully operated since 2004. During 2019/2020 economical throughput production capacity of 20,800 t/y nominal capacity targeted by implementation of the replication model, that providing 12,500 t/y 30% P₂O₅ content ABC- BioPhosphate output products and bio-energy.

3R-BioPhosphate Ltd. targets to enter the global market with its breakthrough technology and offer an innovative recovered organic phosphorus fertilizer as an alternative of currently used mineral phosphate fertilizers delivered from rock phosphate. While the existing supply channels, user habits and market conditions are valid obstacles to achieve significant share in field agriculture, the organic horticultural and the low input agricultural sectors are a significant and rapidly growing open markets for the ABC recovered phosphorus fertiliser.

EU references:

- <http://ec.europa.eu/programmes/horizon2020/en/news/making-green-organic-fertiliser-bones>
- http://cordis.europa.eu/projects/rcn/101165_en.html
- http://cordis.europa.eu/ADS/PROTECTOR_514082_FINAL_REPORT.pdf
- http://cordis.europa.eu/result/rcn/25625_en.html
- <http://phosphorusplatform.eu> (member list, REFERTIL)

Priority working area:

Work field coverage: applied science and industrial engineering and agri/enviro commercial field applications. The three major – 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, most importantly biochar.
Coal & Carbon: reductive thermal science and industrial engineering, pyrolysis oil catalytic conversion and refining; activated carbon manufacturing from hard coal, coconut shell and nuts; biomass and brown coal added value conversions; qualified biochar production and applications; low carbon economy;
- ✓ **Carbon Bio-formulation**, biotech formulation of biochar/carbon for efficient bio and plant availability of nutrient uptake process support.
- ✓ **Carbon Bio-energy**, chemical processing of carbon for synthetic transport liquid fuel (bio-jetfuel kerosene) bio-energy production.
- ✓ **Soil science**: plant available Phosphorous & Nitrogen recycling, soil biotechnology, solid state fermentation and formulation, drought tolerant cultivation methods, biochar carbon offsets.
- ✓ **Climate change mitigation and adaptation**, carbon trading.

Core competence:

- **Phosphorous & Nitrogen recovery and recycling, including special core competence for ABC Animal Bone Char, bone oil and all types of biochar production/applications.**
- Applied environmental scientific RTD in the fields of **zero emission pyrolysis processing**, biochar, nutrient recovery and energy generation processing with integrated and united approach of the advanced thermal-biotech-chemical S&T.
- Development of carbon negative reuse and economical applications of the market demanded recycled output products, most importantly biochar.
- Scale up, full scale industrial engineering and industrialization of zero emission performance reductive thermal processing pyrolysis technologies in any economical throughput capacity ranges.
- Agricultural, food industrial and urban organic waste stream resource added value conversion.
- Environmental and climate protection, carbon capture and mitigation, carbon offset markets.
- Reductive thermal processing of organic material by pyrolysis (agricultural, food industrial, urban, industrial waste, clean coal processing), biochar biotechnological (solid state fermentation) formulation and soil applications, carbon based **resource and nutrient added value recycling** from the agriculture and food industry (**especially phosphorous and nitrogen** from food grade animal bone meal and other sources), **soil science**.

Edward Someus:

International leading scientific and industrial engineering expert in bio-waste and industrial scale biochar added value processing, valorization and reuse applications by pyrolysis and integrated biotech means for Phosphorous and Nitrogen nutrient recycling, enhanced food crop quantity and quality production, restoration of soil natural balance and pyrolysis by-product zero emission recycling. Edward Someus, owner of 3R solely owns all the necessary intellectual property rights to all the key elements of the ABC biochar manufacturing technology and its products. The technology exploitation objective is to enter the global market as biochar manufacturer and also as technology provider for licensed/franchised partners.

Senior Swedish environmental engineer (age 68). Education: University of Lund in Sweden 1972 - 1978, graduated in 1978, M.Sc., Natural and Environmental Sciences. Combining high level of scientific knowledge with industrial engineering and field applications, specializing in the: research, technical development, engineering, permitting, industrial applications and implementation of the zero emission carbon refinery, low temperature carbonisation and torrefaction technology, for recycling and reuse of carboniferous materials by integrated thermal/biotechnological means.

Specializing in the indirectly heated rotary kiln technique and auxiliary installations, such as off gas treatment and biofuel refinery, and **soil biotechnology**. Inventor of the 3R **zero emission carbon refinery** pyrolysis technology and carbon applications for soil improvements, including pyrolysis syngas processing and pyrolysis oil refinery, biochar solid state fermentation and formulation for enhanced and safe food crop productions.

Major EU Commission references (among several others):

NUTRIMAN: Nutrient Management and Nutrient Recovery Thematic Network (H2020 – RUR15 – contract no 818470, coordinator and key S&T tech designer, 2018-2021).

Role in the project: Coordinator, science and technology core work senior engineering.

Project status: ongoing in ten EU countries with 15 partners.

REFERTIL: Reducing mineral fertilisers and chemicals use in agriculture by recycling treated organic waste as compost and bio-char products.

Objective: EU legislation support by definition of improved compost/biochar standards in the EU27.

Project Duration: 48 months, **Starting date:** October 1, 2011.

Programme: European Union 7th Framework Programme (2007-2013), FP7-KBBE-2011.1.2-02

Role in the project: Coordinator, science and technology core work senior engineering

Contract/reference number: 289785, **Project status:** Successfully completed.

Project website: www.refertil.info.

Project status: Successfully completed, follow up developments and high TRL scale ups made.

PROTECTOR, Contract Reference number: ECO/08/238984/ SI2.532247

Programme: CIP Eco-innovation, Project Duration: 48 months (2009-2012)

Role in the project: Coordinator, science and technology core work senior engineering, Phosphorous recycling. **Project status:** Successfully completed, follow up developments and high TRL scale ups made.

PROTECTOR - Recycling and upgrading of bonemeal for environmentally friendly crop protection and nutrition, **Project Duration:** 42 months (2005-2008).

Programme: European Union Sixth Framework Programme (2002-2006), Action: FOOD-2003-T6.6 Recycling and upgrading organic wastes from the food chain in environmentally friendly healthy food production.

Role in the project: Coordinator, science and technology core work senior engineering.

Contract/reference number: FOOD-CT-2005-514082, **Project status:** Successfully completed.

Project status: Successfully completed, follow up developments and high TRL scale ups made.

TDT-3R MULTI FUEL - "Multi Fuel Operated Integrated Clean Energy Process: Thermal Desorption Recycle-Reduce-Reuse Technology".

Project Duration: 36 months (2002-2005).

Programme: European Union Fifth Framework Programme (1998-2002) - Energy, Environment and Sustainable Development specific programme.

Role in the project: Coordinator, science and technology core work senior engineering.

Contract/reference number: EU FP5-NNE5-363-2001.

Project status: Successfully completed, follow up developments and high TRL scale ups made.

Nutri2Cycle: Closing the transition towards a more carbon and nutrient efficient agriculture in Europe (H2020 - SFS-30-2017, 2018 – 2022).

Role in the project: Partner. **Project status:** ongoing.

ECO-ZEO - Developing a pool of novel/eco-efficient applications of zeolite for agriculture sector
Project Duration: 48 months (2012-2016)

Programme: European Union Seventh Framework Programme (2007-2013)

Role in the project: Partner. **Contract/reference number:** 282865, **Status:** successfully completed.

EUPHOROS - Efficient use of inputs in protected horticulture

Project Duration: 48 months (2008-2012)

Programme: European Union Seventh Framework Programme (2007-2013), FP7-KBBE-2007-1

Role in the project: Partner. Contract/reference number: 211457, Status: successfully completed.

Edward Someus is member of the EU JRC/DG Grow work group for biochar EU law harmonization (2016-2018) and EIP-AGRI nutrient recycling WG.

Few selected publications:

- 1) Edward Someus, Massimo Pugliese; Concentrated Phosphorus Recovery from Food Grade Animal Bones; Sustainability 2018, 10, 2349; doi:10.3390/su10072349, www.mdpi.com/journal/sustainability.
- 2) Edward Someus, Massimo Pugliese, Joeke Postma, Henning von Alten, Lea Lavric, REFERTIL–COMPOST AND BIOCHAR TESTING, BioRefine Bulletin, 2015 Issue 3.
- 3) 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. *radicis lycopersici* in tomato, Elsevier, Biological Control 67 (2013) 284–291, 19 July 2013, www.elsevier.com/locate/ybcon
- 4) Postma J., Nijhuis E.H., Someus E., 2010. Selection of phosphorus solubilizing bacteria with biocontrol potential for growth in phosphorus rich animal bone charcoal. Applied Soil Ecology, www.elsevier.com/locate/apsoil
- 5) 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/>

Main aspects that are specific for the 3R Biochar natural product system:

Industrial scale capacities:	From 20,800 t/y throughput and up to any capacity
Environmental/climate performance:	Zero emission, full processing and utilization of all material streams (such as The Process of the Nature)
Environmental/industrial norms/standards:	European Union, Canada, Australia, USA,
Industrial operations:	Continuous >8000 h/y.
All types of biochar formulations:	Yes, as of specific user application market demand
<p>ABC Animal Bone bioChar (<i>carbo animalis</i>) major and well proven application sectors:</p>	All types of natural - organic farming with main focus on horticulture – fruit and vegetable production.
	Forest nursery.
	Black pigment for artistic painting.
	Sugar refinery.
	Wide range of adsorbent, water treatment, filtration, decolorization, fluoride removal.
	Refine crude oil in the production of petroleum jelly.

What we do:

"The secret of success is to do the common thing uncommonly well." -- John D. Rockefeller Jr.

"We cannot solve our problems with the same thinking we used when we created them". (Einstein)

3R = Recycle – Recover – Reuse = Circular economical incentive for combined applied science & industrial engineering for low grade organic by-products added value conversion into high grade resources

<https://www.3Ragrocarbon.com>



1995:

3R-v2 pyrolysis pilot

2020:

3R-v3 pyrolysis industrial scale, long term tested and operated since 2005 for wide range of different types of biomaterial carbonization treatment and pyrolysis oil refinery tests

Industrial production upgrade and TRL9 commercialisation with 2000 t/y and 20,800 t/y capacity is under investment organisation



In a world with finite resources there is no infinite development opportunity with sustainability unless full recycling and circular economy is implemented.

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Biofarm Agri Research Station biotechnological laboratory

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