

Flagship projects University of Miskolc

HORIZON 2020



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Project title

**Material developments for the automotive industry:
fundamental researches in metal forming, heat-treatment and welding**
(TÁMOP-4.2.2.A-11/1/KONV-2012-0029)

Main project data

Main beneficial institution: University of Miskolc
(Faculty of Mechanical Engineering and Informatics)

Members of the Consortium:

University of Miskolc, Institute of Materials Science and Materials Processing
Széchenyi István University, Győr
College of Kecskemét
Bay Zoltán Applied Research Nonprofit Ltd.

Total amount of financial support: 1,577,770 EUR
Intensity of financial support: 100%
Duration: 24 months (01.01.2013.– 31.12.2014.)
Official Website of the project: <http://www.autotech.uni-miskolc.hu>

Motivation

The vehicle industry is one of the most important strategic sectors in Hungary, with high added value, a knowledge intensive branch providing one tenth of the Hungarian GDP. In the global competition, there are often very contradictory requirements against the developments in the automotive industry: from the side of consumers besides the more and more economical operation, increased performance concerning the engine power, the safety and comfort, as well as the overall reduction of harmful emissions meeting the legal requirements on environment protection. Some of these requirements are in harmony, however many of them are in strong contradiction: to meet these contradictory requirements, new materials should be developed and new innovative processes should be invented. Elaboration and application of new materials can be regarded as the main competence of consortium members. Developments to create and establish new application fields to contribute to further developments in the Hungarian automotive industry and to improve its competitiveness are also the main objectives in this project.



● Main objectives of the project

The main target field of the project is to perform complex materials science and materials processing researches in five specialized, synergistically operating Research Groups as listed below:

1. **Welding Research Group:** Investigation of the weldability of conventional new high strength steels and light alloys
2. **Heat-treatment and Surface Engineering Research Group:** Fundamental research works in accordance with international development trends to increase the efficiency of heat- and surface treatment processes
3. **Metal Forming Research Group:** Investigation of the formability of new high strength steels and light metallic alloys, development of new, innovative forming processes
4. **Non-metallic Materials Research Group:** Material developments for the vehicle industry in the field of polymers, nano-composites, graphene- and complex shell structures
5. **Technological Residual Stresses Research Group:** Modelling of technological residual stresses and investigation of their effects on the integrity of vehicle structures

● Links to Horizon 2020 programme

The Horizon 2020 European Union Framework Programme for Research and Innovation also emphasizes the importance of the development of European industrial competences linked to fundamental technologies of key importance. The research program realized within the present project is in close relation with the Horizon 2020 programme in the following points:

1.3. Advanced materials

- 1.3.1 Cross-cutting and enabling materials processing technologies
- 1.3.2. Materials development and transformation
- 1.3.3. Management of materials components
- 1.3.4. Materials for a sustainable and low carbon industry
- 1.3.7. Optimization of the use of materials

1.5. Advanced manufacturing

- 1.5.1. Manufacturing processes applied in future enterprises



Main research activities in the Research Groups

1. **Welding Research Group:** Investigation of the weldability of conventional and newly developed materials with special emphasis on high strength steels and light alloys, including the application of physical modelling and simulation, as well as the complex investigation of the durability of welds against cyclic loads.
2. **Heat-treatment and Surface Engineering Research Group:** Fundamental research works in accordance with international development trends to increase the efficiency of heat- and surface treatment processes; elaboration of qualification methods for quenching liquids; development of plasma-nitriding processes and complex surface examinations techniques.
3. **Metal Forming Research Group:** Investigation of the formability of newly developed materials with special emphasis on high strength steels and light alloys; development of new, innovative forming processes for forming of new materials, application of the methods of Computer Aided Engineering and numerical modelling to improve technological process planning and die design in forming with particular interest for the automotive industry.
4. **Non-metallic Materials Research Group:** Theoretical and experimental investigation and modelling of non-metallic materials applied in the vehicle industry with special regard to the effects of processing on the structure and mechanical properties of polymers, nano-composites, graphene- and complex shell structures.
5. **Technological Residual Stresses Research Group:** Modelling of technological residual stresses and investigation of their effects on the integrity of vehicle structures. Development of new measuring methods to evaluate the effects of residual stresses on vehicle structures.

Project-components



Impact of the project

The fundamental and targeted basic research can result in significant industrial technology developments, leading to the strengthening of university-industry cooperation, creating new, innovative research groups in competitive research fields contributing to boosting and improving the conditions for participating in international research networks, too.



JOINnovation



Project title

**New Environmental Friendly Solder Materials for the Automotive Industry
from Primary and Secondary Resources**
(TÁMOP-4.2.2.A-11/1/KONV-2012-0019)

Project data

Main beneficiary: University of Miskolc
(Faculty of Materials Science and Engineering)

Consortium partners:

Bay Zoltan Nonprofit Ltd. for Applied Research
Hungarian Academy of Sciences (HAS)
Institute for Nuclear Research

Project budget: 2,037,187 EUR

Support ratio: 100%

Duration: 28 months

Contact: batta.beatrix@uni-miskolc.hu

Project webpage: <http://www.forr-asz.uni-miskolc.hu>



Motivation

The use of lead containing soldering alloys in the electronic industry is strictly prohibited by the European Union (**RoHS DIRECTIVE 2002/95/EC**). This principle initiated significant research and development activities worldwide in the fields of production and application of environmental friendly soldering alloys with eligible properties. Another issue is to solve the recycling of wastes from run-down products that the manufacturers of electronic components have to deal with (**WEEE DIRECTIVE 2002/96/EC**). The largest tolerance in applying these directives was given to the manufacturers of automotive electronics, but they also have to switch to the use of lead-free tin-based soldering alloys by 2015. The brazing of heat exchange components is one of the additional challenges of the continuously renewing and developing automotive industry.



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JOINnovation



Scope

The project focuses on two essential fields of the vehicle industry: the electronic units and the cooling systems of engines. The formation of bonds – mostly through soldering or brazing – between the different metallic components is a priority in these two areas. Because of that, the objective of the project is to improve the properties of soldering and brazing joints and the sustainability of the related technologies. This will be achieved through research and development of soldering alloy systems based on material scientific knowledge, the pre-treatment of the surfaces to be joined and the recycling of soldering wastes.



The following five specialized, synergistically operating research groups deal with the above areas:

1. Problems of high purity raw materials and lead-free soldering materials in the automotive applications
2. Development of soldering and brazing materials and their production technologies
3. Pre-treatment of the solder surfaces with plasma cleaning
4. Retrieval of high purity raw materials of lead-free soldering from secondary resources
5. Optimization of the composition of soldering materials with the aid of bulk and interfacial thermodynamics



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HUNGARY'S RENEWAL



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JOInnovation



Linking to the Horizon 2020 programme

The **Horizon 2020 European Union Framework Programme for Research and Innovation** also emphasizes the importance of the development of European industrial competences linked to basic technologies with key importance. The research program realized within the present project is in close relation with the aspects of the Horizon 2020 programme in the following points:

„1.3. Advanced materials

1.3.1 Cross-cutting and enabling materials technologies

1.3.2. Materials development and transformation

1.3.3. Management of materials components

1.3.4. Materials for a sustainable and low-carbon industry

1.3.5. Materials for creative industries

1.3.6. Metrology, characterisation standardization and quality control

1.3.7. Optimisation of the use of materials”



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HUNGARY'S RENEWAL



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JOINnovation



Project components



Impact of the project

The basic and targeted basic research can lead to industrial technology developments through which the quality of the environmental friendly solder joints will be improved and their efficient recycling will be realized.



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HUNGARY'S RENEWAL



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Project title

Basic research on exploitation of national economic development potential of critical raw materials in international cooperation - CriticEL
(TÁMOP-4.2.2.A-11/1/KONV-2012-0005)



Project data

Main beneficiary: University of Miskolc
(Faculty of Earth Science and Engineering)
Accepted total cost of the project: 1,600,000 EUR
Support ratio: 100%
Duration: 24 months
Contact: ejtimreg@uni-miskolc.hu
Project webpage: <http://kritikuselemek.uni-miskolc.hu/>



Motivation

Nowadays regions of the developed countries (Europe, United States and Japan) suffer from the repeating effects of several crises. Reasons for these crisis phenomena are the disruption of the current balance of raw material sources disposal and the higher cost and insecurity of import which has had easy access so far. The existence of suitable quantity and quality of raw material is essential for the European and Hungarian economy; therefore, EU has required the assessment, exploration and evaluation of strategic importance mineral resources in its member states. Priority should be ensured to the trainings for raw material extraction and processing technologies. Raw Materials Group – which was organised under the European Commission – published a report that defined 14 types of raw material ranked according to the expected industrial demand and the possible source of supply, from which Europe may significantly rely on import to the current extraction rates in 2030



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CRITICEL
critical elements

and the concentration of whose primary sources involves risk and uncertainties for the EU. The developed countries of the EU have taken significant steps to ensure the supply of raw materials. Germany, for example, had established the independent Mineral Resources Agency in 2010 and negotiated with Mongolia about the common development of mineral resources. These materials are essential for the production of modern cars, TFT monitors, smart phones, hybrid cars, catalysts, solar cells, wind turbines, batteries and the strong, but lightweight components. In the following decades the sharpest market demand will be expected from these raw materials in Europe, therefore, research on these elements has to be renewed. Hungary as most countries of Europe is a net importer of raw materials, it has a significant dependence from the distant sources. Despite of this fact the country is significantly behind with the research of energy and other mineral sources and with the development of exploitation and technologies of production. From 2011 political resolutions have been published according to which the national mineral resources have important roles in the planning of national economy's strategic directions.



Scope

The aim of the CriticEl project is to contribute the economic and social modernization of Hungary with economic recovery, the incentive of high-tech and green-tech industry. In the interest of this project; University of Miskolc launches basic research programs in the chosen strategic areas. The expected scientific results will give information of the following topics:

- The exploration of availability of critical primary and secondary raw materials and a comprehensive database of them;
- Development of commodity research methods that can be used for detection of the critical strategic raw materials in near-surface waste stockpiles or in slag heaps.



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CRITICAL
critical elements

- Survey of national recovery and exploitation possibilities, analysis of application of different technologies;
- Examination of application of raw material preparation technologies from primary and secondary sources, results of applied research and technological development;
- Economic aspects of technologies application;
- Results of logistical analysis of distributed raw material's collection, possibilities of optimisation;
- Recycling-friendly product design and manufacturing technology analysis, principles and recommendations;
- Results for investment decision-making;
- Results for national strategic decision-making of critical raw material projects.



Linking to the Horizon 2020 programme

The research program realized within the present project is in close relation with the aspects of the **Horizon 2020 programme** in the following points:

“Industrial leadership

- 1.3. Advanced materials
- 1.5. Advanced manufacturing and processing

Societal Challenges

- 3. Secure, clean and efficient energy;
- 4. Smart, green and integrated transport;
- 5. Climate action, resource efficiency and raw materials”



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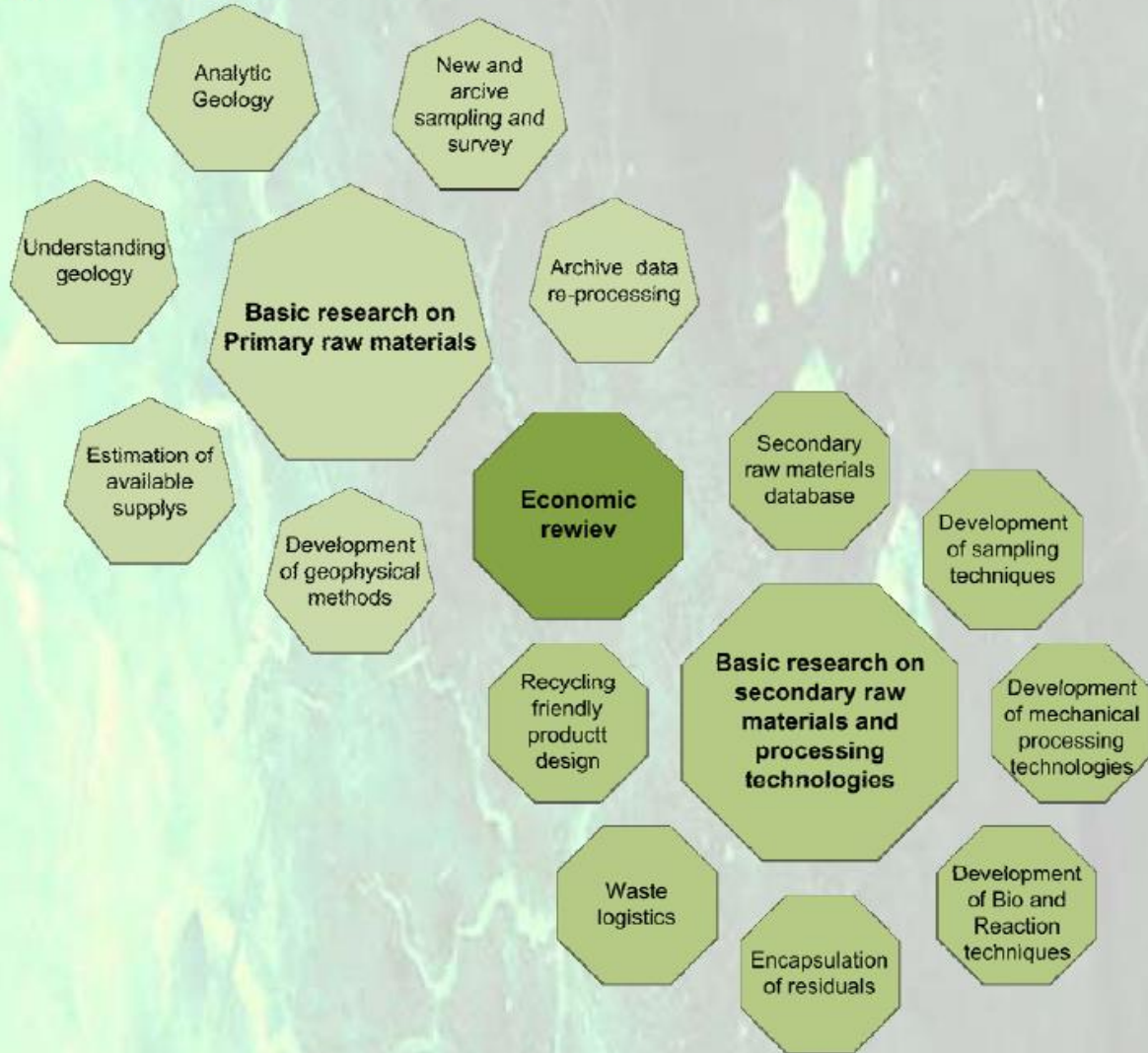
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CRITICAL
critical elements



Project elements



Impact of the project

Geological survey and basic research results technological implementation of which contributes reducing Europe's raw material supply risk and also increase the recycle of secondary raw materials and development of the efficiency of raw material extraction and processing technologies.



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Project title

WELL aHEAD – Improving the groundwater related research potential based on applied and fundamental R&D activities at the University of Miskolc, Faculty of Earth Science and Engineering (TÁMOP-4.2.2.A-11/1/KONV-2012-0049)

Project data

Funded institution: University of Miskolc
(Faculty of Earth Science and Engineering)
Project budget: 1,589,674 EUR
Support ratio: 100%
Duration: 28 months
Contact: kutfo@uni-miskolc.hu
Project webpage: <http://www.kutfo.uni-miskolc.hu/>



Motivation

The new European Planning period, launching in 2014 often referred to as **Horizon 2020** has several priorities related to protection of water resources. Two out of the seven priorities of the national **New Szechenyi Plan of Hungary** assigns top preference to better utilization of groundwater resources. The Faculty of Earth Science and Engineering of the University of Miskolc, as a key technical research entity of North East Hungary is dedicated to find solution to regional issues of the global sustainable water resource management challenges, thus further developing its range of competence. Our goal is to strengthen the international prestige of the research centre and improve the international scientific visibility of our young researchers through collaboration with research institutions and key players of the market.



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Scope

A remarkable milestone of modern hydrogeology is the introduction of the local and regional groundwater flow systems theory, published by Joseph Tóth in 1963. Concerning the technical (engineering) applicability of the theory there was no any research conducted in Hungary before, thus the planned fundamental research agenda of the project mainly covers the engineering and water management aspects of the flow system theory applications. Covering issues such as sustainable thermal water-, mineral water-, cure water-, and drinking water management, anthropogenic effects on groundwater resources, ecohydrogeology, and complex multidisciplinary research of porous and karstic aquifers.

The research goals are structured around five relevant subtopics and their technical investigation. These are defined as 5 research modules. Each module set up its research teams working on 3-4 R&D ideas involving more than 70 researchers altogether. Besides the five research modules the project aims to develop its own technical knowledge transfer concept. Some of the research results shall be utilized via direct industrial partnership (e.g. patents, technology developments) while other shall be further developed through the international networking activity of the project and through the formulation of new proposals in the Horizon2020 calls, starting from 2014.

...A SOURCE OF FRESH THOUGHTS
IN GROUNDWATER MANAGEMENT



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Project elements

1. Complex hydrogeological research on mineral-, cure-, and thermal water investigation and utilization in North-East Hungary

2. Better understanding of interaction between cold and warm karst water bodies

3. Investigating the impact of mining activities on groundwater resources

4. Better understanding of subsurface transport processes of special contaminants

5. The impact of extreme weather conditions on groundwater recharge and water cycle

Linking to the Horizon 2020 programme

We expect that our efforts shall be continued in Framework program proposals as we approach the Horizon 2020 calls. We have competence and seek partners in the following thematic priorities:

- Protection of the environment and sustainable management of natural resources and groundwater
- Developing integrated approaches for the sustainable management of water-related challenges
- Understanding risks related to extreme precipitation events (Climate change)



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Impact of the project

It is an important aim of the project to develop the research potential at the Department of Hydrogeology and Engineering Geology with adjacent competences of the Faculty of Earth Science and Engineering. We also put a strong emphasis on the networking activity both in a domestic and international scope. Similarly important goal is to support the new generation of researchers. We intend to use the resources of the project to employ young scientists (PhD students, postdocs) keeping well educated experts in the North-East Hungary region.

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IN GROUNDWATER MANAGEMENT



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