

Hun-cycling Recycling, circular economy on the example of Nádasrét in Miskolc

László Bencző

Hungarian University of Agricultural and Life Sciences
PhD student, Doctoral School of Economics and Regional Sciences
E-mail: lbenczo@deltech.hu

ABSTRACT

My study deals with the recultivation of the infertile heap and slag dump of the former Lenin Metallurgical Works in the center of Miskolc and the possible reuse and use of the area. The subject of my publication is the possibility of recycling slags with varying physical and chemical compositions – accumulated as by-products of iron and steel production in the above-mentioned, currently defunct metallurgical plant. I will further analyze and narrow down the topic, moving towards waste management and recultivation, examining it from a social and economic point of view.

Keywords: regional development, rural economy, regional relations systems, growth, recovery, recycling

JEL Classification: R10, R11

Mathematics Subject Classification Number: 92F05

1. INTRODUCTION

Some regions have become winners, while others have become suffering subjects of a transformation called "regime change." Forman (2001), This is closely related to the fact that urbanization and the process of the expansion and resettlement of multinational companies are the most intensive in the most developed areas today – escaping the urbanization, development, or underdevelopment of the regions arising for specific reasons, and therefore, their situation must also be treated uniquely (Baros et al., 2012; Bujdosó et al., 2013). Likely, remedying the problems of the micro-regions would also improve the situation of their wider environment; therefore in-depth analyses would benefit the entire country. Horváth (2009) In addition to the natural conditions, the improvement of all differences between regions is significantly influenced by the economic characteristics of the region, the amount and quality of human resources, the accessibility, and infrastructure of the region, and the local quality of life (Hojcska-Szabó. 2021).

My research goal is to present as a sample the 36-hectare area in the center of Miskolc, which I consider suitable as an energy-producing place after recultivation. Furthermore, how the raw material extracted during recultivation, as well as the recycled area, can be utilized for the community. Nagy (2003), Páger (2011), Péli (2013), Káposzta, Ritter, Nagy (2016)

2. LITERATURE BACKGROUND

As a result of the increasing demand for civil engineering materials such as cement concrete, a shortage of natural aggregates has developed in some areas due to the over-exploitation of mines. On the other hand, the development of industrialization indirectly led to more industrial waste. Due to the high use of construction materials, replacing natural aggregates with industrial waste can significantly reduce the use of both natural resources and industrial landfills.

Steel slag is a solid industrial by-product of steel production and is a promising alternative additive in concrete due to its unique properties. Steel slag is produced during the extraction of impurities from steel with lime (CaO), dolomite (MgO), and other auxiliary materials. It accounts for approximately 12–20% by weight of total steel production. About 100 and 16 million tons of steel slag are released annually in China and the United States, respectively. Its mineral composition is similar to cement clinker and includes amorphous silica (SiO₂), calcium oxide (CaO), tricalcium silicate (3CaO·SiO₂ or C₃S), dicalcium silicate (2CaO·SiO₂ or C₂S) and tetra calcium aluminoferrite (4CaO·Al₂O₃) contains Fe₂O₃ or C₄AF) Chen et al.(2020)

Due to its active hydrating components, finely ground steel slag is used as a mineral additive in cement or concrete. Coarse steel slag can be used directly as an alternative to natural additives. Iron and steel slags are by-products of steel production. These mineral raw materials mainly consist of lime silicate compounds and are classified as secondary raw materials and not as waste because of their homogeneous and advantageous properties. Iron and steel slags are valuable raw materials that are obtained during the pig iron and crude steel production processes. Two main production methods are involved. In the iron ore-based process, pig iron is produced from oxidic iron ores in a blast furnace. In the purely scrap-based production variant, raw steel is produced by recycling steel scrap in an electric arc furnace. Depending on which of these production processes is used, one speaks of blast furnace slag or steelworks slag. The terms blast furnace slag and granulated blast furnace slag, as well as, the slag and electric furnace slag are used for finer distinctions.

With high-quality iron ore grades with an iron content of 64 to 67 %, a blast furnace typically produces about 0.25 to 0.30 t of slag per t of pig iron. In the case of inferior-grade ores below 60 %, the amount of slag is typically 0.35 to 0.50 slag/t of pig iron. In 2018, approximately 1247 million tonnes (Mt) of pig iron were produced worldwide, compared to 1212 Mt in 2017, leading to the production of approximately 330 to 375 Mt of blast furnace slag (BFS). Europe accounts for 8.3 % (103.9 Mt) of production, and North America 2.5 % (30.8 Mt). China alone accounts for 61.9 % (771.1 Mt), Japan produces 6.2 % (77.3 Mt), and India 5.7 % (71.5 Mt). The regions with the lowest production volumes include the Middle East (0.2 %) and Africa (0.4 %).

According to the World Steel Association, roughly 0.126 slag/t of crude steel is produced using the BOF process (Basic Oxygen Furnace), and 0.169 slag/t of crude steel using the EAF process (Electric Arc Furnace). Global crude steel production in 2018 was approximately 1807.1 Mt. 70.8 % of the current crude steel production is accounted for by the BOF process, 28.8 % by the EAF process, and only

0.4 % by other processes such as the Siemens-Martin process. Derived from these figures, the annual quantities of steelworks slag amount to a total of 250 Mt, of which around 65 % are BOF or LD slags and 35 % EAF slags. In total, there are around 600 Mt of slags from the steel industry worldwide, of which 58 % are BFS and 42 % are steelworks slags.

3. SLAG RECYCLING AND THE CIRCULAR ECONOMY

Iron and steel slags are already making a significant contribution to the circular economy in numerous countries. Almost all of the slag from the steel industry in those countries is used for the manufacturing of high-quality products for the cement and building materials industries, aggregates for road construction, and fertilizers. Only small quantities end up in waste disposal sites or are used for landfilling. Unfortunately, this is not the case everywhere in the world, partly because there is a lack of suitable rules and regulations or because in many countries little importance is placed on resource conservation.

4. GLOBAL MARKET DATA

The utilization rates for iron and steel slags are very different from region to region or country to country. The leading regions and countries of the world are examined in more detail below. Strictly speaking, the term recycling only applies to recycling within the steel industry

4.1 Europe

In Europe, EUROSILAG records the production and slag recovery quantities every two years. The data for the EU28 is derived from the reports published by the 19 most important countries and data from the World Steel Association for pig iron production. The result for 2018 comes to 20.7 Mt of blast furnace slag and 16.3 Mt of steelworks slag or 37.0 Mt of total steel and iron works slag. In 2016, the figures were still 24.6 Mt of blast furnace slag and 18.4 Mt of steelworks slag. The production of blast furnace slag has thus fallen by 15.9 % in the past two years, while that of steelworks slag has dropped by 11.4 %. In that period, pig iron production only decreased by 2.5 % in the EU28, and crude steel production even increased from 162 Mt to 167.6 Mta and is currently (2019) at 159.4 Mt.

The Waste Framework Directive 2008/98/EC also regulated the recycling of iron and steel slags. The production volume was 20.7 Mt, of which 86.0 % was sand slag from slag granulation and 14 % was air-cooled BFS. From interim storage, 1.5 Mt was added to the production quantities, so a total of 22.3 Mt of BFS was used in 2018. 17.9 Mt went into the production of cement and concrete, 4.0 Mt went into road construction, and 0.4 Mt into other uses. Granulated blast furnace slag is primarily used in Europe for the production of portland blast furnace cement. The necessary grinding of the slag to the finenesses required for cement is now mostly performed in vertical mills, which achieve throughputs of over 100 t/h.

Of the 16.3 Mt of steelworks slag in Europe, 52.3 % are BOF slag, 34.9 % are EAF slag and 12.6 % are other types of steelworks slag. Of this amount, 11.8 Mt, or 72.4 % was recovered, 15.3 % went to

interim storage, and 12.3 % to dumps and landfills. With 70.6 %, the greater proportion was used as aggregate in the production of concrete instead of gravel and grit. The quantities used in cement production are negligible compared to the quantities used in concrete production. Only 1.3 % of the produced slag was used in road construction, while 4.5 % was used in hydraulic engineering. A relatively large amount of 13.1 % was used as fertilizer, and the remaining 10.5 % was recycled in metallurgical processes or used in other applications.

4.2 Germany

Is one of the model countries in slag recycling. In 2018, the country produced 27.271 Mt of pig iron and a total of 42.435 Mt of crude steel. This corresponds to 30 % of the total pig iron production and 25.3 % of crude steel production in the EU28. As a result, Germany produced 13.18 Mt of iron and steel slag, of which 7.79 Mt were blast furnace slags and 5.39 Mt were steelworks slags. The quantity utilized was 8.83 Mt since a further 1.04 Mt became available through the reduction of inventory stocks. The majority (83.7 %) was granulated blast furnace slag (slag sand) used for cement production, while a further 1.2 % of slag sand went into the production of concrete. The remaining quantities went as BFS into the production of aggregates or other building materials. Of the 5.39 Mt of steelworks slag in Germany, 59.4 % was BOF slag, 30.2 % was EAF steelworks slag and 10.4 % was slag from special processes. 3.83 Mt or 71.1 % of these slags were utilized, while 15.2 % went to interim storage and 13.7 % to disposal sites or landfills. With 2.43 Mt or approx. 61 %, utilization as a building material (road construction, earthworks, hydraulic engineering) accounts for the largest amount, followed by recycling in metallurgical processes with 18.5 % and use as fertilizer with 9.7 %.

The greatest economic benefit is gained by the use of granulated blast furnace slag in the cement industry for the production of Portland blast furnace cement and other Portland blended cement. When the liquid (molten) slag is quenched with water in a granulation plant, a glassy and granular product is created, which must subsequently be ground to produce a fine powder, which is used as a clinker substitute. Ground granulated blast furnace slag (GGBFS) has similar cement-like properties to Portland cement. The glass content of GGBFS varies between 60 % and 100 % by volume, depending on the granulation process. For many applications, blast furnace slag cement have even better properties than conventional Portland cement.

4.3 USA

In the USA, about 17.0 Mt of iron and steel slag was produced in 2019, after 15.7 Mt in 2016. The production output of pig iron and crude steel has recently increased slightly by around 2 %. No slag recovery data is available for 2019, but estimates from the US Geological Survey (USGS) assume that the quantity recovered will comprise approximately 50 % blast furnace slag and 50 % steelworks slag. Blast furnace slag accounts for 88 % of the commercial value. In the USA, the slag is processed at a total of 129 locations by 28 companies. This also includes companies that import or grind and export granulated blast furnace slag. The import quantities for slag (mostly granulated blast furnace slag) in

the USA were 2.3 Mt in 2019 after 2.0 Mt in 2016. In 2016, 8.2 Mt of blast furnace slag was produced, of which only 2.9 Mt (35.4 %) was granulated slag and 5.3 Mt (64.6 %) was air-cooled blast furnace slag. In addition, 7.4 Mt of steelworks slag was produced. From these figures can be seen that granulated blast furnace slag (GBFS) can be used as a cement additive. For ready-mixed concrete and other types of concrete, both normal blast furnace slag and steelworks slag are used with respective totals of 38.7 % and 20.3 %. However, these slags are mainly used for road construction. Steelworks slag is also suitable as a filler and as a raw material for clinker production. A market for slag cement has developed in the USA. The market peaked at 3.819 Mt in 2019 having increased practically continuously since 2010, after the end of the economic crisis. The increase in production volumes in 2019 was 10.8 % over the previous year, after an 11 % increase in 2018. The results show that slag cement is in vogue in the USA and that the existing granulation plants cannot meet the demand alone. That is why around 2.3 Mt of ground-granulated blast furnace slag was imported in 2019. Companies that use slag cement in the USA emphasize the CO₂-saving effect compared to conventional OPC (Ordinary Portland Cement).

4.4 Japan

The use of iron and steel slag has a long tradition in Japan. However, the produced quantity of blast furnace slag decreased from 25.4 Mt in 2007 to 23.0 Mt in 2017, but the proportion of granulated slag rose slightly from 82.6 % to 84.4 %. By international comparison, these figures give Japan a leading position. First of all, it is very noteworthy that the slag recovery rate is 100 %. Amounts that are simply dumped in other countries are used for soil improvement in Japan. 88 % or 17.5 Mt of the country's granulated blast furnace slag is used in cement production, 7.3 % is used in the production of concrete, and 2.1 % in the construction industry. 1.3 % goes to unspecified applications. The amount of steelworks slags in Japan has decreased from 15.2 Mt in 2007 to 13.7 Mt, which of course has to do with the decrease in crude steel production from 120.2 to 104.7 M in this period. The shares of BOF steelworks slag compared to EAF steelworks slag increased in Japan from 75.9 % to 79.9 % in the same period. The steelworks slags were almost 100 % recovered. The large quantities sold to the cement industry are interesting. However, unlike GBFS, steelworks slags are not used as a cement additive, but as an alternative raw material for clinker production. The likewise large quantities of 3.52 Mt for BOF slag and 0.91 Mt for EAF slag relate to their use as a filler in the construction industry.

4.5 China

The utilization of iron and steel slags has increased significantly in recent years. In 2018, the country produced about 225 Mt of blast furnace slag and about 122 Mt of steelworks slag after 200 Mt and 81.5 Mta respectively in 2010. There are still big differences in the utilization of the different slags. The number of granulation plants for blast furnace slag has grown strongly. Since around 2000, the most important Chinese steel producers have been investing in granulation and grinding plants for blast furnace slag. It is currently estimated that 95 % of the blast furnace slag is granulated and used entirely in the cement and concrete industry. Almost 70 % of the steelworks slag goes to dumps and landfills.

The most important types of utilization with 9.3 % are the application as raw material for clinker production and recycling within the metal industry.

4.6 Brazil

By-products from the steel industry consist of 42 % blast furnace slag, 27 % steelworks slag, and 31 % other by-products such as dust, sludges, etc., according to figures from the Brazil Steel Institute for 2017. 92 % of the approximately 8.8 Mt of blast furnace slag was recycled in 2017, of which 99 % went to cement production. Of the approximately 5.6 Mt of steelworks slags, 36 % were recovered in 2017 and 23 % were recycled within the steel industry. The recovered quantities went almost entirely to road construction. Unfortunately, the Steel Institute has no information on the number of granulation plants for blast furnace slag in Brazil. However, it is assumed that almost every blast furnace is equipped with such a plant since long-standing supply contracts exist between the steel industry and the cement companies.

4.7 South Korea

The production of blast furnace slag grew significantly in the years leading up to 2017. In 2019, the industry came under pressure due to pollution problems, and steel production fell by 1.5 % compared to the previous year. There are only two steel companies, POSCO and Hyundai, with POSCO having a market share of 76 % in blast furnace slag production in 2011 and a share of 73.3 % in 2017. Slag imports accounted for 5.2 % of the total in 2017. Granulated slag makes up 86 %, of which almost the entire amount is used in the cement industry. The fields of application of air-cooled slag are mainly in road construction and other uses in the construction industry. (recovery-worldwide.com, 2020)

5. EU DIRECTIVES

Based on the Directives of the European Union and the National Waste Management Plan I, and II, the recovery of waste has been given a prominent role. The utilization of construction and demolition waste and industrial by-products, such as slag, generates an environmentally friendly product. Slags with varying physical and chemical compositions are produced as by-products of iron and steel production in large metallurgical plants. Slag rocks formed by metallurgical processes can be regarded as industrial rocks.

6. PRIMER RESEARCH METHOD, BOILER METALLURGICAL LABORATORY TEST

My research method was personal sampling at the beginning of March 2022. From the slag storage area, 5 pieces, each weighing 30-40 kg. I took the samples from the surface of the slag mounds. I identified the samples (ÚT/A-1-ÚT/A-5) on the spot and indicated the identification marks for the basic laboratory tests. According to the test results, a specially designed and strictly adhered homogenization technology can be used to produce a mixture of materials suitable for paving bases without binders from the material characterized by samples ÚT/A-1-ÚT/A-5. Based on different approaches, I examined how can, after recultivation, renewable energy communities be created and how they can operate in

the field of study, in the long term. While explaining the topic in depth, I will refer to the areas and settlements with similar characteristics, and social and economic conditions, where energy communities can be established in the EU or even in a wider radius. The liquidation of DAM Diósgyőri Acélgyártó Rt., which continued to operate steelworks in Diósgyőr on the site of the former Lenin Metallurgical Works, started on 14 March 2000 and operation was continued by DAM Steel Rt. Following the liquidation of the company in 2003, DAM 2004 Kft. acquired it in 2004, and started to restart the plant, which ceased its activities in 2008. DAM 2004 Kft. was engaged in the production and trade of steel semi-finished products from iron and steel scrap. The process included the production of liquid steel from steel scrap (Ultra High Furnace UHP, electric furnace, nominal capacity: 550,000 t/year) and the setting of the desired composition (ASEA-SKF under vacuum and atmospheric pressure heating ladle metallurgy, respectively), as well as the casting of liquid steel (continuous steel casting plant, nominal capacity: 550,000 t / year), further processing of cast and cut-to-size steel semi-finished products (steel block grinding and hot rolling), maintenance and repair of the machines used for the production of the castings.

The ASEA-SKF ladle furnace unit was used for the further refining and post-treatment of steel produced in the primary steel production plant (UHP furnace). The ladle furnace system consisted of 6 refining stations: 2 sintering units, 2 heating units, 1 vacuuming unit, a vacuum refresher unit, and 1 steel homogenizing unit without heat transfer. The equipment was installed symmetrically, and the vacuum unit was placed in the middle so that all the steel in the 2 heating positions could be fed into the vacuum unit and the vacuuming could be done. The capacity of the ASEA-SKF ladle furnace unit was 400,000 t / year. W. Shen et al. (2020),

The slag was removed from the UHP unit using a trolley and then new slag was formed by adding lime and hydrate burnt in the heating unit. The chemical composition was then adjusted, deflated, and removed if necessary after arcing, magnetic stirring, and Ar-rinsing. By performing the technological operations, the steel was cast in the Foundry. In the course of the activities of DAM 2004 Kft., The ASEA slag generated in the steelworks was transported to a collection point at the northern end of the coke oven. Due to its properties, ASEA slag was stored separately, its collection point is not concreted, and no protection against dusting has been established (Figure 1).

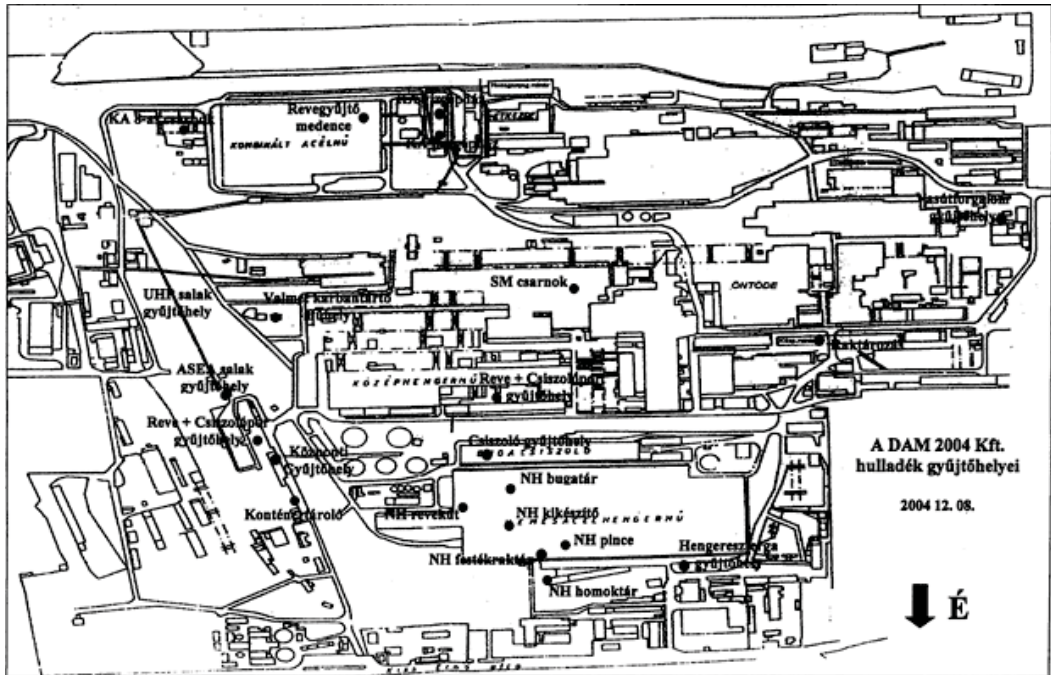


Figure 1. Waste collection sites of DAM 2004 Kft. (Internal documentation of DAM 2004 Kft.)

In Hungary, huge slag dumps were formed in 3 metallurgical plants, in Diósgyőr, Ózd, and Dunaújváros. The utilization of the slag dumps, quickly recognizing the suitability of slag stone for road construction, was started by building road foundations in lowland areas, and in areas poor in granular stone and river gravel. From ungraded metallurgical slags with a grain size distribution of 0-200mm, and up to 300mm of the excavated material, so-called scattered road bases of 25-30cm thick were constructed. The inhomogeneous, variable grain size distribution and material quality of the original metallurgical slags made it necessary to develop products and product groups to meet the requirements. Slag-processing plants were established and operated in each metallurgical plant for the production of products that met the needs.

6.1 Slag and slag dump in Miskolc



Figure 2. DAM 2004 Ltd. waste collection site, Miskolc on Nádasrét, satellite image 2022

According to the conditions of the formation of metallurgical slag in Diósgyőr, it represents the combination of the metallurgical form formed during the production of raw iron, Siemens-Martin, LD, and electro-steel slag varieties. The majority of the slags found on the historical piles in Diósgyőr are of steel production origin, sold predominantly in granulated form. A smelter shape was placed on the historical pile only if granulation did not take place for various (mainly technical) reasons. Slag generated by steel-making, which makes up the bulk of the stored slag, was placed in the slag cauldron in a liquid state during the production process, where the slag remained partly solidified, partly semi-liquid, and malleable until the cauldron was emptied. A plan of extraction has been drawn up for the exploitation of metallurgical slag stored on the historical pile in unprocessed slag mounds; during processing, the metal that can be extracted by magnet was first extracted, and then the slag was classified by two separators with a nominal capacity of a total of 200 tonnes/hour, using different lines of sieves. They didn't have a crushing device.

The estimated amount of total unprocessed and locally stored metallurgical slag in Diósgyőr is 36 hectares, 3,000,000 cubic meters, which includes mixed (barren) slag of varying particle size mixed with soil residues from slag sorting, slag sorted into fractions and unprocessed slag, which is an indefinable quantity.

6.2 As a secondary investigation, I conducted an environmental protection investigation

A wide range of expert studies carried out for the implementation of Act CXXXVIII of 2003 on the development of the expressway network shows that the material from the smelting slag hills, an indispensable by-product of the iron and steel industry, can be used for the construction of roads and motorways. Tóth, Káposzta (2014)

6.3 Waste materials that make up the historical slag pile

In the waste of the slag, the crushed grains and rubble of the artificially created industrial rock are mixed with a little sandy soil and debris of construction materials. The processing residue of metallurgical slag can also be considered a secondary industrial raw material due to its known useful properties. Based on the list of wastes of the KöM decree 16/2001 (VII. 18.), we list its components from an environmental protection point of view with the code number of the European Waste Catalog (EWC):

10 02 01 waste from the treatment (processing) of slag (barren)

10 02 02 untreated slag

16 11 04 lining and refractory materials used in metallurgical processes

17 01 07 concrete, brick, tile, and ceramic debris

17 05 04 soil and gravel mixture

According to the aforementioned regulation, the listed materials are not hazardous waste. The typical mineral composition of metallurgical slags in Diósgyőr does not differ significantly from metallurgical slags produced in other countries. It is characterized by a relatively high calcium content, which classifies the slag as a basic slag type. Federal Highway Administration (2000), Reid (2000) The chemical composition varies depending on the production and the mineral composition of the raw materials. The suitability for road construction is influenced by the mass ratio of CaO and MgO. Within this, dicalcium silicate Ca_2SiO_4 , tricalcium silicate Ca_3SiO_5 , and free CaO. The main components that make up the slag are the Earth's crust-forming elements, which also occur en masse in nature. K.K. Sideris et al. (2018)

6.4 Other substances found in slag piles

The processing and cultivation experiences proved that in the past, coarser crushed slag, larger pieces of concrete, and less often rubber, iron, and plastic waste were irregularly deposited on the historical pile in some cases. These constituents impair the building suitability of slag (must be sorted during utilization), but the environmental protection rating of slag is not affected. Hjelm (2016), Van der Zwan (2017)

6.5 The effect of slag – built into embankments – on the subsoil and groundwater of the construction area

When placing it in a given environment, the associated risk factors must be examined based on the indicated properties – using a complex assessment. For example, over hydrogeological protective structures, water bases open from above, even a small risk can have a significant effect. In other environments, e.g. agricultural, it can be incorporated into a road embankment without harmful effects or protective measures.

7. A COMPREHENSIVE STUDY OF THE EUROPEAN UNION REGULATION OF THE ENERGY COMMUNITY

The "energy community" (in the English version of the EU directive No. EU 2019/9441; "citizen energy community", in Hungarian translation "local energy community") is a legal entity: - which is based on voluntary and open participation and which is managed by members or shareholders, who are natural persons, small businesses, local authorities, including municipalities; - the primary purpose of which is not financial gain, but to provide environmental, economic and social community benefits for its members or shareholders, or their area of operation; - which may participate in energy production, including renewable source-based production, energy distribution, energy supply, energy consumption, aggregation, energy storage or energy efficiency services, or electric vehicle charging services, and may also provide other energy services to its members or shareholders.

Domestic regulation Electricity Act (VET): LXXXVI of 2007 Act on Electricity 2 § 66/B. "The energy community is a legal entity operating in the form of a cooperative or non-profit business company, the primary purpose of which is not to obtain financial profit, but to provide environmental, economic and social community benefits for its members, or in the operational area specified in the energy community's founding document provide benefits by performing at least one of the activities of electricity production, storage, consumption, provision of distribution flexibility services, electricity distribution, aggregation, provision of electromobility services by the Road Traffic Act and operation of electric charging equipment. Aggregation The combining of power plants, user equipment, and electricity storage facilities connected to the power grid or private lines for the purpose of sale, purchase, or auction in the electricity market. An aggregator is a market participant performing this activity. Energy communities need a permit for these activities. However, the energy community cannot carry out transmission system management, electricity distribution, electricity trade, and universal service and cannot operate an organized electricity market. Your activity cannot cross the border. Participation in the energy community may not adversely affect the acquired rights and obligations of the user regulated in this law. A natural or legal person whose occupation or primary economic activity is in the field of electricity or gas supply, or who has sole or majority ownership or decisive influence in such a legal person, or who is a senior official of such a legal person cannot be the managing director of the energy community or a member of its management or its affiliated enterprise, which carries out its main activity in the mentioned area.

Act LXXXVI of 2007 on electricity, addition to Section 3 of the Act (VET): - "Producer-consumer: an active user who produces electricity for his own consumption from a renewable energy source, or stores and sells electricity produced by himself from a renewable energy source in such a way that, in the case of a legal entity, is considered an activity carried out for the purpose of his independent occupation or primary economic activity." –

"Producer-consumers acting together: at least two producer-consumers who, in accordance with Section 17c, carry out their activities in the same building and agree to act jointly in this regard." Section 66/B of the VET is supplemented by the following paragraph (1a): "The rules applicable to the energy community must be applied to the renewable energy community with the fact that the renewable energy community is an energy community that produces electricity from renewable energy sources, consumes such electricity, store or sell. The actual management of the renewable energy community is provided by the member or members whose connection points of the places of use are located in the same high/medium voltage transformer station area as the connection points of the electricity storage and power plant owned by the renewable energy community."

8. RESEARCH RESULT, CONCLUSION

In Diósgyőr, the residual product of iron and steel production, the metallurgical slag of varied composition, is deposited in an area delimited by residential buildings, which cannot be further expanded. In this study, I examined whether it is suitable in its current state, and how it can be made suitable for the road base layers without fill and binder on the slag and slag-barren roads in Diósgyőr, as well as whether the area is suitable for further development as a result of recultivation for the installation of a possible energy production system according to the following:

If the necessary test compaction for all types of metallurgical slag found on site conforms, and a test section is completed with favorable results, then after the necessary laboratory tests have been performed, there is no obstacle to obtaining a construction industry application permit for the tested earthwork and road base layers.

Furthermore, the examination of whether or not an energy-generating system can be installed in the reclaimed area according to the conditions below, for which the tasks to be performed in the target area are as follows:

1. Detailed analysis/survey of the primary energy consumption of the target area.
2. Examination of social and economic aspects within the target area. On the basis of social and economic aspects, an examination of the areas within the catchment area of Nádasrét that are suitable for the creation of renewable energy communities and their long-term operation, i.e. which areas and settlements currently have such social and economic conditions, where energy communities could be established.

Investigating the social and economic conditions that a given region must-have for the feasibility and sustainable operation of renewable energy communities.

3. Investigations of the legal and other conditions for the creation of renewable energy communities in the target area, and the possibility of establishing a good practice.

9. REFERENCES

1. Forman, B. (2001): Structural and pre-accession foundations of the European Union. Publisher: az Hungarian Delegation of the European Commission, Budapest, 2001. (In Hungarian)
2. Horváth, Gy. (2009): Preliminary thoughts on the role of reindustrialization and environmental protection in regional development. In: Béla BARANYI – István FODOR (ed.): The role of the environmental industry in the regional reindustrialization in Hungary. MTA Regional Research Center. Debrecen-Pécs, 2009. pp. 9-18. (In Hungarian)
3. Nagy, H. (2003): Problems and questions in the Hungarian regional policy. MendelNet
4. Páger, B. (2011): The role of the environmental industry in the development of Saxony-Anhalt. OTDK thesis. (In Hungarian)
5. Péli, L. (2013): The main regional economic relationships of growth poles investigation in Hungary. PhD dissertation, Gödöllő, 2013. (In Hungarian)
6. Káposzta J.-Ritter K.-Nagy H. (2016): Local Economic Development in Transition 2002/3, Brno, ISBN 80-7302-045-9, ISBN 80-7302-046-7 pp. 213–219. Economies: A Tool for Sustainable Development of Rural Areas. In: Vasily Erokhin (szerk.): Global Perspectives on Trade Integration and Economies in Transition. USA: IGI Global, 2016. (ISBN 9781522504528) pp. 281-298.
7. Chen, Xueqin (2021) Recycling of steel slag aggregate in portland cement concrete <https://doi.org/10.1016/j.jclepro.2020.124447>
8. [Slag recycling - recovery \(recovery-worldwide.com\)](https://www.recovery-worldwide.com) 2020
9. W. Shen et al. (2020) Ecological carbonated steel slag pervious concrete prepared as a key material of sponge city
10. Tóth, T.-Káposzta, J. (ed.) (2014): Design methods and procedures for in rural development (theory). Gödöllő: Szent István University Publishing House, 2014. p. 163. (ISBN:978-963-269-407-8) (In Hungarian)
11. Recycled Materials in European Highway Environments: Uses, Technologies, and Policies. (2000): Federal Highway Administration U.S. Department of Transportation. Washington D.C. 20590.
12. J.M. Reid (2000): The use of alternative materials in road construction. Transport Research Laboratory, Crowthorne (UK).
13. K.K. Sideris et al. (2018) Mechanical characteristics and durability of self-compacting concrete produced with ladle furnace slag.
14. Hjelmar, O. (2016): Waste management in Denmark. Cycle and Stabilization Technologies of MSW Waste-to-Energy Residues, Waste Management, Vol.16. Number 516. (Editor: William A. Cauley), Elsevier Science Ltd., Oxford, UK.
15. Van der Zwan, J.Th. – Henneveld, R.J.P. (2017): Sustainable development and road construction. International Road Federation World Meeting, Toronto, Canada.
16. Baros, Z. - Bujdosó, Z. - Kovács, T. - Patkós, Cs. - Radics, Zs. (2012): The social aspects and public acceptance of biomass giving the example of a Hungarian region International Journal Of Renewable Energy Development 1(2) 39-43. <https://doi.org/10.14710/ijred.1.2.39-43>

17. Bujdosó, Z. - Patkós, Cs. - Radics, Zs. - Baros, Z. - Dávid, L. - Kovács, T. (2013): The Importance and Public Acceptance of Biomass and “Green Energy” – the Example of an Underdeveloped Hungarian Region Journal Of Central European Green Innovation 1 : 2 pp. 13-25
18. Hojcska, A.E. & Szabó, Z. (2021). Investigating Natural Treatment Factors and Inequalities of Medicinal Water Institutions in the Aspect of Tourism in Hungary. GeoJournal of Tourism and Geosites, 36(2spl), 555–562. <https://doi.org/10.30892/gtg.362spl01-683>
19. T.A. & Isakov, Aleksandr. (2017). Recycling of dust-like zinc and iron-containing wastes of electric furnace steelmaking. International Journal of Ecology and Development. 32. 115-120.