Evaluation of environmental performance and a way towards sustainability with LCA in the region of North Hungary

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Abstract

The region of Northern Hungary, and especially the county of Borsod-Abaúj-Zemplén, is one of the most controversial regions in Hungary. Despite its excellent natural and environmental potentials, and its role in preserving traditional culture and its role as an umbilical cord, it is in a very difficult situation regarding the economy and social progress: its performance indicators or the indices related to sustainability and measuring human development cannot be claimed to be good. However, the positive changes in the recent period – e.g. in terms of the environmental compliance of companies, waste emission, use of chemicals in agriculture, institutional development, programmed awareness raising and shaping attitudes in general and higher education – hold out hope.

In our presentation we would like to present the current situation of industrial/energy sector in the Northern Hungarian Region, and evaluate the environmental performance of power plants and chemical companies with LCA analyses. Generally, it can be mentioned that, in Hungary only the first steps of LCA applications can be observed. However, during the last few years, several initiatives appeared in LCA researches in our country. For instance, some companies began to evaluate their environmental performance with LCA software in order to correspond to the principles of sustainable development.

This paper gives an overview on our LCA works, projects and results, which can have a positive effect both on regional and country sustainability performances.

Keywords: region of Northern Hungary, controversial, environmental performance, energy industry, chemical companies, LCA, first steps.

WIT Transactions on Ecology and the Environment, Vol 102, © 2007 WIT Press
www.witpress.com, ISSN 1743-3541 (on-line)
doi:10.2495/SDP070311

1 Introduction

The county of Borsod-Abaúj-Zemplén is one of the most controversial regions of Hungary. Despite its excellent natural features and potentials, its opportunities to preserve traditional culture and its geopolitical potentials, it is in a very difficult situation: it faces serious economic, social and environmental problems and its performance indicators or the indices related to sustainability and measuring human development cannot be claimed to be good.

B.A.Z. county as statistically part of the Northern Hungarian region is the second largest agglomeration in the country with its 7247 km^2 and with the highest number of settlements (357).

As far as economic development is concerned, some indicators show an almost threefold increase, but the annual increase in the decisive per capita GDP hardly exceeds 1%, according to the statistical data of the National Statistics Office (KSH) [2]. The income indicators show a minimum change over a ten year period, and compared with the national average the position of the county deteriorated, which indicates among other things that it is still very far from the Lisbon objectives.

The development of the region is even poorer in terms of social progress. Employment has showed only a moderate improvement since the crisis of the structural changes. It is unfavourable that for 100 active wage earners in the region there are 92 dependants (24 unemployed), while the national average is 67 dependants, including 10 unemployed.

The development of the unemployment rate (16%! in 1993) is the worst in the country.

At the same time one of the highest fertility rate indicators can be found here.

It should be noted, however, that the increase in the industrial production in Northern Hungary, including the county of Borsod-Abaúj-Zemplén was the largest in the country with an average increase of 15-16% from 2003 to 2004, which is a promising sign of the improvement of economic capacity and employment also.

1.1 Economic and social situation

Examining the geopolitical and economic role of this region, two features can be highlighted:

- this area connects the Hungarian Plain (Alföld) with the highland areas
- it also has a connecting role between Northern-Eastern Hungary, the Tokaj region and the capital.

The structural reforms in the early 1990s shocked both the economy and the society of the county, having been former heavy industrial centre of Hungary ("Hungarian Ruhr"). The socio-economic crisis caused by the dissolution of the heavy industry made one third of the settlements of the region lag behind the country average performance.

In a comparison with other areas of the country, this region is the last on the rank of GDP per capita, reaching only 64 % of the country's average in 2002

(KSH [2]), relative to the European Union the situation is even worse, performing only 37,2 % of the EU's average (NORDA [3]). Enterpriser spirit also lags behind the country's average, 58 active enterprises coming at every 1000 inhabitants in the region (while the country's average is 87) (KSH [2]). The situation is adverse on the field of research and development as well. Concerning the ratio of R&D investments to GDP, the region stands at the lowest place of the list (0,18%). In domestic relations it stands on the one before the last place concerning either R&D expenditures or labour employed in R&D. About six to ten R&D experts come at every 1000 inhabitants in the region, while this ratio is 53,3 to 1000 in the Central Hungarian Region.

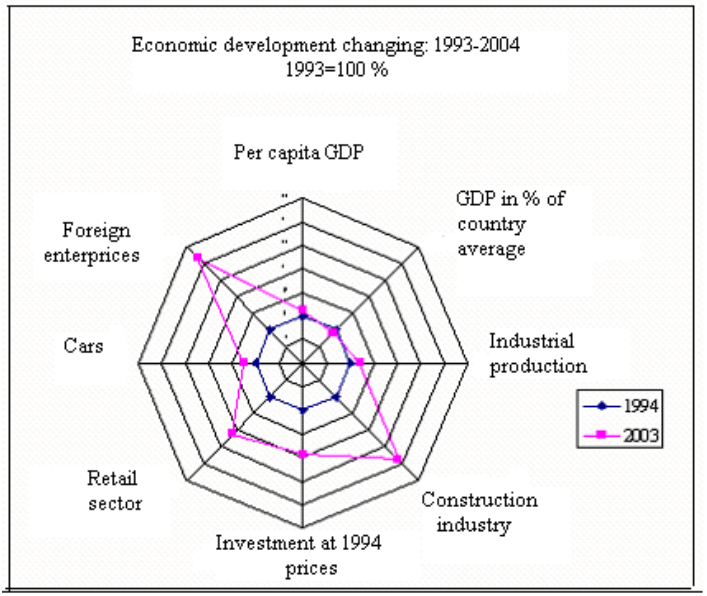

Figure 1: Economic development according to certain indicators (*source: Tóth Szita and Buday-Malik,* [5]).

Most significant factors of the region's backwardness:

- *negative demographical changes* (decrease in the number of population, high rate of migration)
- *low standard of living*
- *isolation* (underdeveloped channels of telecommunication, high number of small villages and peripheral regions)
- *decrease in production and in income producing capacity*
- *insufficient utilisation of natural resources and geopolitical opportunities*

- *lack of modernisation techniques* (both in the industry and telecommunication)
- *unbalanced environmental conditions*

The unfavourable economic prospects are mirrored in the unemployment rate of the region as well, fluctuating around ten percent (NORDA [3]). At social level, the negative side-effects of polarisation and transmigration can be monitored besides high unemployment. Almost all demographic indicators (the level of education, standards of living, expected length of life and so on) show an inimical picture of the regions' situation. Encouraging signs emerge at tourism, and the highway's attractiveness for capital can be captured in new tendencies as well.

The human development index (HDI) is one of the lowest in this region of Hungary. HDI was 0.618 in Northern Hungary, while it was 0.709 in Central Hungary in 2002.

1.2 Environmental conditions

The dissolution of heavy industry and the decline in industrial production were beneficial to the general state of the environment, the quality-improvement of the air, natural waters and soil happened mainly due to that.

The perfection of piped gas networks also contributed to the improvement of air-quality. Other explanations for the positive tendencies of the last years can be found in the modernisation and reconstruction of the polluters and the accomplishment of environmental investments. The quality of surface waters has also improved, thanks to the structural changes of the economy; still, in the case of under-surface waters the picture is less favourable. The shortage of water is accompanied by a high level of hardness of it, nitrate-pollution and other contaminations. The largest part of noise- and vibration contamination accrues from transportation, still pollution limits are exceeded several times. The pollution caused by drainage means the largest danger for the water-basis. The sewers build-up does not reach the level of the drinking water supply networks, thus part of the cess-water pollutes the water-basis.

The overall size of territories standing under environmental protection (national parks, landscape-protection areas and nature reserves) is 190.105 acres, which is the highest of all Hungarian regions, and is expected to increase even more, thanks to Hungary's accession to the NATURA network in 2000 (Natura 2000 network consists of fields appointed in two directives of the European Union, dealing with environment-protection – the directive **79/409/EEC** on the Conservation of Wild Birds for marking special reservations for the protection of birds, codified in 1979, and the Habitats Directive, codified in 1992 (**43/92/EEC**) aiming to mark special nature-reserve territories. The statutory order 275/2004 (X. 8.) comprises of the rules of marking the nature-reserves, apportioned to the European Community.)

The protection of the environment is a key factor in the defence of the region's main heritage, the variability of the flora and the landscape.

2 Environmental performance of industry and energy sector

2.1 Environmental performance of Northern Hungarian Region in LCA approach

Life Cycle Assessment is a holistic assessment of the environmental performance of products and services. It measures how much impact a product has both directly and indirectly. It covers all phases of the product's life cycle and it covers all significant environmental impacts. This method is known in Hungary since 1991, but it is not applied in large field. Now, we adopted the LCA method to analyse the environmental impact in the region. It is a new approach in both of the Regional Economics and Environmental Economics too. The System burden was the region's borders itself; the functional unit was 1 unit of GDP in USD. We use simplified material balance: applied the energy consumption and the main emissions of the characteristics industrial sector, as Mineral industry, Production and processing of metals, Energy industry and Chemical industry. The input materials were simplified for the fuel, the emission data came from EPER database. On this way we could to compare the eco-efficiency too. As the figure 2 shows, the NHR has been in worse condition than Hungarian GDP processing in average. Firstly we have built the Hungarian energy mix; it was generated by GVOP project and SimaPro database.

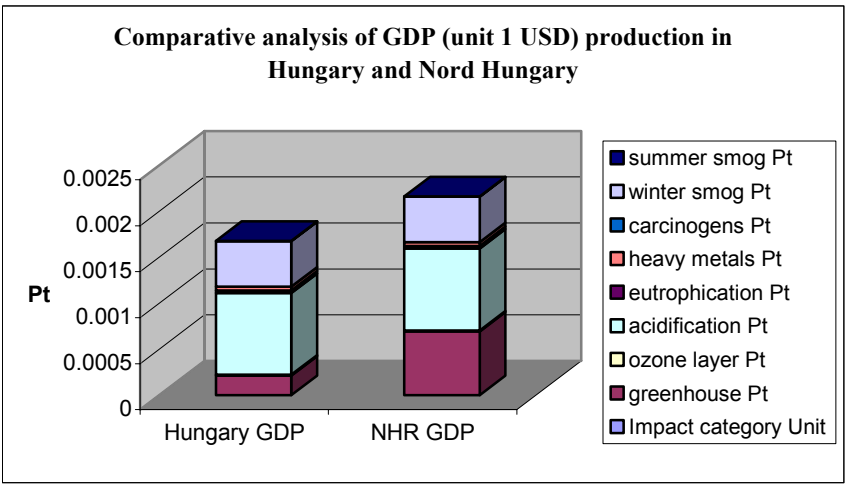

Figure 2: Comparative analysis of GDP (unit 1 USD) production in Hungary and Nord Hungary (*source: Simapro 7.0-Eco-indicator 95 method, own assessment,* Tóth, 2006).

The investments in environmental protection showed a relatively favourable image of the field, although the increase is more modest if the deflation index is

taken into consideration. The majority of investments are related to sewage management.

It should be noted that the statistics of the late 1990s gave a deceptive picture of the county: its environmental indicators – due to the termination of the heavy industry operations – definitely improved. It was clearly shown in the statistical data relevant for the production of hazardous waste and the pollutant emissions of industrial plants

2.2 Electricity production in Hungary and in the Northern Hungarian Region

The energy consumption of a country depends on several factors: demographic conditions, economy, living standard, energy-prices, and climate. The population of the world, which was 6 billion, consumed 400 EJ energy in millenary by 60 MJ/ capita/year specific consumption. In Hungary the electricity production increased from 27.463 GWh to 35.745 GWh in the period of 1990 – 2005. Obviously, there were several changes in the energy sector from 1990. According to the earlier theories, fossil energy sources would be replaced by nuclear energy, but nowadays, it is clear that, renewable should be in favour. It is important to increase the rate of renewable energy from the aspect of energy policy, rural development, environmental management and the undertaking towards to the EU. In 2002, about 1% of electricity production came from renewable sources. According to the European Union requirements, this rate should be increased to 3,6% by 2010. In the past few years there were several activities, investments in Hungary to increase the electricity production from renewable sources. It results the followings by 2005:

- The utilization of renewable energy sources – especially biomass – are doubled,
- Electricity production from wind power is increased (50%).

With this, Hungary fulfil the EU requirements, the rate of electricity production from renewable resources is more than 5%.

According to IEA Energy Statistics, In Hungary the average electricity consumption is about 3.545 kWh pro capita. But data in the following figure display that this is much lower (2.100 kWh) in the Northern Hungarian Region.

2.3 Life cycle inventory of the Hungarian energy sector

The University of Miskolc in cooperation with the Bay Zoltán Foundation for Applied Research is working on the following LCA project: “Development of a National LCA database for supporting the environmentally sound development” GVOP 3.1.1.2004-05-0248/3.0. The aims of this project are to establish an online LCA database in the area of energy- and waste management.

It is required to take into account of every input and output flows for life cycle assessment. In the following table we present the life cycle inventory of the Hungarian energy sector, regarding to 1 MJ produced electricity. We made the inventory of input and output side from grave to cradle.

Table 1: Power plants in the region, 2000.

Power Plant	Year of establishment	Capacity (MW)	Energy source	Efficiency
Mátra Power Plant Ltd.	1968-69	200	Lignite + biomass	28,81
Mátra Power Plant Ltd.	1970-71	636	Lignite + biomass	29,76
Tisza	1976-78	860	oil	36,51
Borsodi	1954-56	137	Coal+biomass	41,47
Borsodchem	2001	49	gas	
Kisköre		160 GW	Hydro power	

Source: Energy supply in Hungary, the role of the most important energy sources in the energy supply in the world and in Hungary.

The Mátra Power Plant is the 2nd highest capacity power plant in Hungary. The electricity production appoints improving eco-efficiency, regarding to both fuels, and emissions. The sulphur – dioxide emissions are under the limit, because of the desulphurization.

The growing biomass utilization in power plants results to fossil fuel savings, and contribute to carbon – dioxide emission decrease. Data in the following figure indicate emissive of the different type power plants.

Table 2: Emissions per 1 MJ electricity produced by fuel.

Emission	Olaj	Coal	Lignite	Gas	Biomass	Waste
CO2	0,1164	0,3176	0,2983	0,23241	0,00069	0,5122
CO	4,36e-5	1,99e-4	1,58e-4	3,52e-5	2,7e-4	5,59
NOx	1,22e-4	4,64e-4	2,9e-4	6,08e-5	6,9e-4	4,5e-4
Dust	9,48e-5	1,59e-5	3,37e-6	-	-	-
SO2	1,65e-4	5,17e-4	1,63e-4	6,08e-5	6,928e-4	3,98e-5

Source: Hungarian Energy mix, 2006 [6].

By the fossil energy sources, the biomass is more and more important in the energy production in the Northern Hungary Region. The chronology of the renewable energy production is the following in the region:

a) Hydro power: Tisza Power Plant Ltd (Tiszalök, Kisköre) does not fill important part in the energy production (167 GWh).
b) Biomass: appears in different forms (wood, wood chips, wood shavings, agricultural waste, meat flour, etc.). The Borsod Power Plant was the first biomass (wood, wood chips, wood shavings) heated power plant in the region. The technology change was important in the aspect of the power plant subsistence. The originally lignite fired Mátra Power Plant

uses wood shavings, seed coat, meal, rape. Besides, it fires meat flour, too, which means "indirect" incineration. (Because of the food safety requirements, it is not possible to use meat flour –contains photogene causative agents- as feed.)

c) Wind energy utilization is the newest investment in the region (Felsőzsolca, 2006). The new wind energy power plant with 2 MW capacity can insure the night lighting energy demand of Miskolc.
d) The solar energy utilization appears as the part of the consumer energy savings program.

Last but not least, there are several programs under development, which intend to utilize the renewable energy sources, currently.

3 Assessment of environmental performance and LCA in practice

In Hungary only a few researchers and companies deal with life cycle assessment. Mostly, they use different LCA software – developed in other countries – for the evaluation.

The following problems can be detected in the research field:

1. currently available databases contain no data for Central and Eastern European Countries (CEEC)
2. lack of up-to-date information (the majority of the data is from 1996.)

Consequently, these analyses appoint non-Hungarian statements, because of the difference of energy industry. It was the reason why we decided to develop the Hungarian LCA database. The Bay Zoltán Foundation for Applied Research, in co-operation with the University of Miskolc is working on the project *"Development of a national LCA database for supporting the environmentally sound development of the Hungarian enterprises".* It is supported by Economical Competitiveness Operative Programme (GVOP-3.1.1.-2004-05-0248/3.0.).

In this project data inventory is based on results of the international research, with consideration of Hungarian conditions. Focal points are: energy- and waste management. The most popular LCA software (SimaPro, GaBi) have been used for data production and as assessment tools.

By developing the Hungarian energy-mix, it would be possible to get proper and reliable results in our LCA analyses. This fundamental LCA database could help small and medium-sized enterprises to design environmentally and could make the availability of objective environmental assessment easier. Furthermore, its positive effects on market positions, business opportunities, consumption models and on sustainability performance cannot be doubtful.

An online version of the system will be available for public users.

4 Conclusions

The need of integrated and sustainable development may present huge challenges mostly for backward regions such as the region of Northern Hungary. In

addition, the environmental motivation of development cannot be called traditional here.

Focal points of breaking out of backwardness are: *competitiveness*, *better quality of life*, *fought against migration and unemployment, environmental compliance*. However, there are not only strategically plans but positive results in performance also: e.g. in terms of the foreign investments, industrial production, environmental compliance of companies, waste emission, use of chemicals in agriculture, institutional development, programmed environmental education and last but not least in R&D activities.

Biggest opportunities for the region are in its absorption capacity, integrated strategically planning in rural development, investment in creating jobs, promoting interregional cooperation and in education and adult training.

The LCA is might a potential tool to assessment the development of a region and the way towards sustainability. It could give a complex index to comparative analysis.

References

[1] EPER, http://www.eper.eu.int

[2] KSH: Az Észak-Magyarországi régió kistérségeinek, illetve Magyarország régióinak legfontosabb társadalmi-gazdasági jellemzői számokban Központi Statisztikai Hivatal Borsod-Abaúj-Zemplén Megyei Igazgatósága, Miskolc, 2004

[3] NORDA: Helyzetelemzés (munkaanyag) Észak-Magyarországi régió Miskolc, NORDA, Tervezési csoport 2004. November 30

[4] ROP: Regionális Fejlesztés Operatív Program 2004-2006 Magyar Köztársaság Miniszterelnöki Hivatal, 2003

[5] Tóth Szita, K., Buday-Malik A., The county of Borsod-Abaúj-Zemplén: on the way to sustainability? European integration studies. 2006. (Vol 5.) No. 1. [24 p.]

[6] Zsolt Istvan, Hungarian Energy mix, Project Report of GVOP 3.3.1.- 2006