THE ROLE OF ENVIRONMENTAL INDUSTRY IN THE REGIONAL REINDUSTRIALISATION IN HUNGARY

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PREFACE

The economic crisis processes, going on in the world and having a detrimental effect on Hungary too, have once again drawn academic attention to the issues of reindustrialisation, especially in the transition countries of East-Central Europe: this is the region where, due to the former political and socio-economic systemic change process, an especially intensive de-industrialisation process took place. The closedown of a significant part of the industrial plants resulted in serious socio-economic and societal problems in these countries that have only recently joined the European community, including Hungary.

Within the issue of reindustrialisation, an issue of primary importance, the issues related to the role of environmental industry are given a special emphasis, in connection with the processes of the global climate change. Those academic views by which environmental industry should play a selected role in reindustrialisation are more and more widely accepted. Environmental industry, using the achievements of the academic sector, is expected to be the sector with the most dynamically expanding market both in the international arena and in Hungary. The ever strengthening sector offers great possibilities for the increase of the competitiveness of companies engaged in environmental activities in Hungary.

Bearing this in mind, with the support of the Ministry of Environment and Water Management and coordinated by the Centre for Regional Studies of the Hungarian Academy of Sciences (CRS of HAS), the researchers dealing with in-depth survey of this topic decided to publish a book that analyses the role of environmental industry in the potential reindustrialisation of the regions and the promotion of sustainable economic development. The editors and the authors of this volume considered the fact that environmental industry includes all those producing activities that use clean technologies safeguarding effective prevention, pollution management technologies and the use of environment friendly resources. This sector has a vital importance in our time, when the natural and environmental consequences of the economic growth are becoming more and more striking.

It is true that this environmental industry, a special field of industrial activities, has shown a promising growth rate in the recent years in the developed countries, which was possible because it proved to be a suitable platform for the activation of the growth factors of the advanced economies: knowledge and innovation. In addition, the need to meet the environmental requirements of the European Union promotes the further development of this sector in industry n this region. For the improvement of the competitiveness and exportability of this sector in Hungary there is a political will, expressed in several governments cycles by now.

The essays of this book deal with the Hungarian characteristics and possibilities of environmental industry; each chapter was written on the different segments of this industry. The subjects of the chapters started from the recognition that environmental industry offers a realistic opportunity for regional development based on innovative industries. The book also gives an international outlook to help the reader draw the conclusions relevant for Hungary. Taking the characteristic Hungarian features into consideration, the book places a special emphasis on biomass-based renewable energy production and the related issues of waste management. Several chapters were written on the topic of climate change, an issue of utmost importance in the environmental debates, and the relevances of climate change for the environmental industry.

The volume summarising the most recent research findings on the issues of environmental industry is published in English language, for the 25th anniversary of the foundation of the CRS of HAS, the basis institution of the Hungarian regional (spatial) sciences, and also for the celebration of the Feast of Hungarian Science. We hope that this book written by recognised experts and edited by professors Béla Baranyi and István Fodor will make a significant contribution to the professional foundation and implementation of the tasks arising in connection with the reindustrialisation of the regions of Hungary, and not last to the introduction of the achievements of the researches of the Hungarian scientists both in Hungary and abroad.

Having all this in mind I recommend this book to all those who are interested and especially to the experts dealing both with the theoretical and the practical issues of environmental industry.

Budapest, April 2009

Lajos Oláh
State secretary

PRELIMINARY THOUGHTS ON THE ROLE OF REINDUSTRIALISATION AND ENVIRONMENTAL PROTECTION IN REGIONAL DEVELOPMENT

Gyula Horváth

I.

One of the strategic research fields of the Centre for Regional Studies of the Hungarian Academy of Sciences is the analysis of regional and urban paths of development. The objective of researches is to encourage decision-makers to adapt and apply new ideas, and to draw the attention of main sectoral policy organs to the necessity of decentralising modern factors of territorial structure formation. In recent years, R&D, technological change and industrial development were in the focus of scientific debates.

The debates concluded that most Hungarian regions are unable to attract modern and developed services due to their weak industrial potential. Development of institutional relations and inner regional cohesion are hindered by the lack of networking companies, industrial parks, clusters, modern and diverse secondary or university level engineering training. We acknowledged with regret that these facts were overlooked in regional development documents, leading to the absence of complex industrial development programmes.

If we compare Hungarian regional data with those of other CEE countries, we find that three out of seven Hungarian regions (the Northern and Southern Great Plains and Southern Transdanubia) are weakly industrialised, showing a lower degree of integration and a rather heterogeneous inner structure. The industry in these regions, controlled primarily from Budapest, suffered greatly from economic transformation. The Southern Great Plains and Southern Transdanubia underwent the transformation crisis without experiencing widespread and profound tensions. However, the slow agony has exceeded the tolerance limits of economic sustainability and tends towards depression. The difference between depression and stagnation combined with fluctuating intensities of slow growth is that the former is characterised by continuously rising unemployment, rare periods of economic growth caused by short-run conjunctural phenomena, foreign investors tend to overlook less developed regions, highly educated young professionals flee from these depressed areas, even from their natal regions.

The three regions are characterised by poor economic performance and low growth rates. Their regional GDP per head is only 75 percent of the national average, and the gap is constantly increasing. If we observe the percentage of industrial workers, only two Hungarian regions show rates exceeding 30 percent. Our analysis of Czech regions gives an utterly different picture. The rate of industrial workers in seven out of the eight Czech regions exceeds 30 percent. While the GDP per capita for Prague exceeds 200 percent of the national average, respective rates of other regions converge with it. In Hungary, the GDP index of the Central Hungarian region exceeds the national average GDP more and more, while variations between GDP values for the Central and the Western Transdanubian regions and the national average have been stable for years. The data observed in the rest of the regions indicate the presence of increasingly unfavourable conditions (*Figure 1*).

The service sector was responsible for the changes in the employment structure of the economy of the four lagging Hungarian regions; agricultural employment exceeds the national average in the two regions of the Great Plains and in Southern Transdanubia.

Due to their present industrial structure, obsolete product mix, the saturation of traditional tertiary branches and the low standard of technology, it is impossible to expand the export capacities in these regions even in the presence of favourable conjunctural conditions.

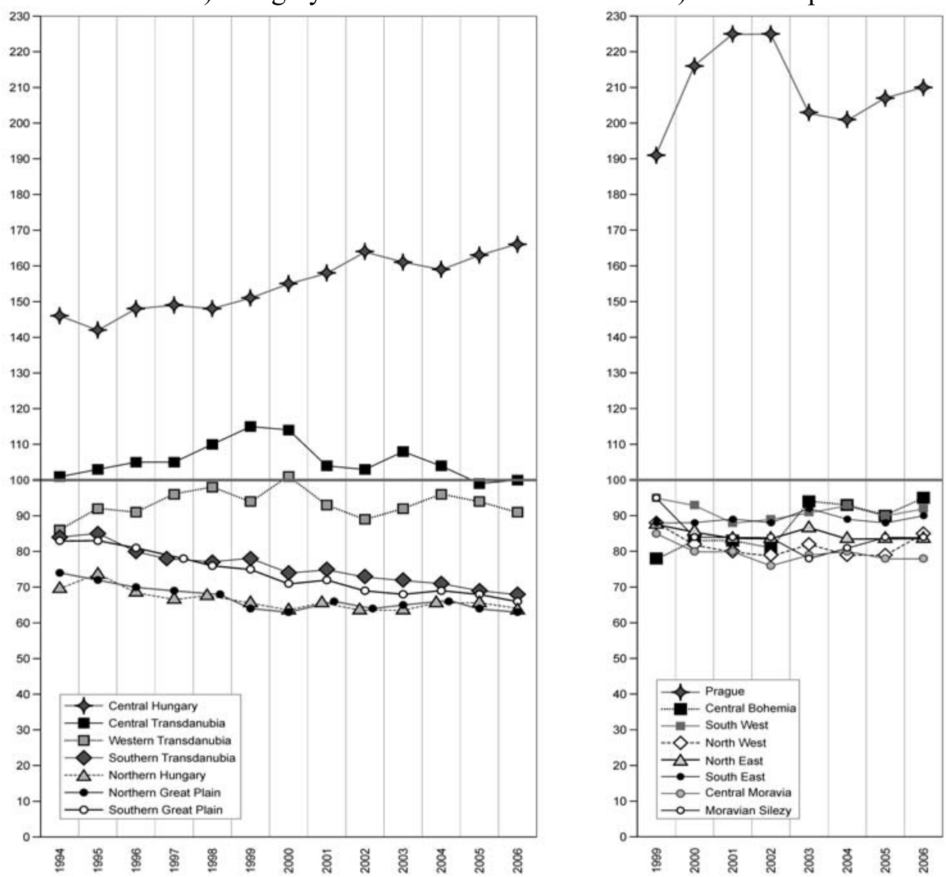
These Hungarian regions demonstrate the weakest export orientation in the country. Only 3,1 percent of FDI inflows of Hungary were located in these regions. The volume of FDI per capita in the two Transdanubian counties is particularly low, HUF 81.5 million (1 Euro = 264 HUF in 2006) in Baranya, and HUF 57.3 million in Tolna county. The national average was HUF 536.6 million. The value of product exports of machinery industry companies (HUF 263 billion) accounts for one-twelfth of the Central Transdanubian region's exports (HUF 3,318 billion). The export volume of food industry products is half of the Great Plain's exports. R&D capacities are insufficient, the share of research expenditure in GDP is below 33 percent of the national average, and levels of expenditure per researcher are the lowest in the country. The poor accessibility of the region inhibits the further amelioration of regional competitiveness. One could continue listing the numerous economic indices illustrating the fact that South Transdanubia and the Southern Great Plains have sunk to the level of the other two underdeveloped regions.

The dominance of industry in FDI activity can be observed in all of the provincial regions, yet more than 40 percent of foreign manufacturing companies are concentrated in the Central Hungarian region. Eighty percent of total foreign manufacturing investment is located in the three most developed regions, and the economic weight of these areas has somewhat grown during recent years. Reindustrialisation stimulated by foreign capital has aggravated regional disparities. The North Transdanubian counties profited the most from foreign manufacturing investment; the level of capital stock of foreign companies located in these areas is over twice as high as in the other four provincial regions.

Figure 1

The evolution of regional GDP rates in two countries
(Percent deviation from national average, 1994−2006)

a) Hungary b) Czech Republic



Source: The author's calculations based on National Statistical Yearbooks.

Reindustrialisation in Western and Northern Europe emerged as a sign of the economic paradigm shift of the 1980s. After the downsizing or disappearance of traditional branches of industry (extractive, heavy and textile industry, etc.) new industrial branches emerged in traditional industrial spaces, industrial training institutes were transformed, and significant progress was made in forming institutional linkages between industry and R&D. Meanwhile, industry and a wide range of related highly developed services have gained an important place in development strategies of formerly less industrialised areas.

II.

Reindustrialisation means neither halting of the industrialisation nor rebirth of the former trends; rather, it is a complex process referring to new, innovative industries and to the sectoral and spatial restructuring of industry. Reindustrialisation means the appearance of new branches, activities and products in areas where these were formerly non-existent on one hand, and on the other hand it refers to structural change through which the role of traditional branches is eliminated or suppressed, to be taken over by other newly emerging activities.

In the world, there are no territories where we can find clear processes: deindustrialisation, delocalisation and the new, innovative industry emerge simultaneously, complementing or crossing each other. The territorial types of industry are determined by the dominant processes: in the developed world we can witness a rise in the significance of innovative industrial branches in parallel with the overall retreat of industry. The Central and Eastern European countries situated on the border between the developed and the developing world have become attractive sites for FDI from the developed world, and at present, they are winners of delocalisation processes. The new industry is also present in the newly industrialised countries (NIC) experiencing continuous growth in traditional sectors (*Barta − Czirfusz − Kukely*, 2008).

In the Centre for Regional Studies of HAS, the results of the research conducted by *Györgyi Barta* indicate that the delocalisation of R&D activities into foreign countries is a central element of the new corporate strategies. Although in most cases the delocalisation of R&D is centred in the developed world, the phenomenon of delocalisation of R&D to developing countries did emerge around the turn of the millennium. As a result of this process, Hungary emerged on the map containing the sites of R&D relocation of multinational enterprises, and is a highly preferred spot from the aspects of cost saving and the substitution of talented and skilled workforce (*Barta − Kukely* et al., 2007).

The research also called attention to the large disparities between foreign and domestic corporate R&D companies: foreign owned companies provide 75 percent of R&D expenditure, foreign research units are six times larger than domestic ones, and there is a 15-fold difference in the area of per unit costs. The available results of our research point towards the weak embeddedness of foreign corporate R&D units. As a result of foreign investments, a dual structure has emerged even in the field of R&D. The basic interest of the Hungarian economic policy is to support the local embeddedness of foreign R&D units and to promote their cooperative linkages with domestic companies, research institutes and universities.

Reactions of the Central and Eastern European countries to the structural crisis of the industry vary from country to country. There are numerous positive results. In the Czech Republic, Romania and Poland, possessing diversified manufacturing areas as a heritage from the planned economy period, significant decentralised bases of engineering formation and research were created, dominant features of reindustralisation can be detected both in the structure, the volume of production and in the presence of FDI. The research results of *Gábor Lux* indicate that the survival of industrial structures in Central and Eastern Europe is a result of a combination of factors. One such factor is the abundant factor supply, i.e. the availability and the sufficient quantity and quality of factors of production, particularly of qualified employees, at a competitive price. Another significant factor is the institutional background of regions: chambers of commerce, promotional agencies, local governments, different forms of informal cooperative linkages between economic actors (development coalitions, lobby groups), and the societal background including education, training and the industrial – entrepreneurial culture (*Lux*, 2007).

There is a shortage in the availability of professional engineers in most Hungarian regions, the obstacle in front of rural industrial development lies in the shortage of engineers and skilled workers employable in medium and high-tech industries. In the South Transdanubian economy, the growth of added value is expected from a comprehensive strategy of reindustrialisation, and raising the intellectual level of activities necessitates the availability of highly educated and skilled workforce. In Hungary, only the Budapest University of Technology and Economics offers global engineering training fulfilling the standards of modern industry. There are no multifunctional engineering faculties with rich industrial linkages in the three large university centres (Debrecen, Szeged and Pécs). This lacune is a competitiveness disadvantage for Hungary. The impact of the presence of engineering faculties or technological universities in Košice, Timişoara, Cluj-Napoca, Braşov, Novi Sad exercises long-lasting favourable effects even in our day.

III.

Environmental protection industry is one of the most perspective branches of reindustrialisation. As a result of globalisation, technological mutations, and new political priorities, the "environmental products and services industry" has become a constantly expanding, autonomous economic factor.

According to the results of a survey made by a leading German counselling company, Roland Berger, covering 1500 companies and 250 research institutes, environmental protection and technology industry is developing at such a rapid pace in Germany, that by the year 2020:

- the output of the branch will exceed the output from the manufacturing of machinery and equipment,
- the share of the branch in total industrial output will grow from the present 4 percent to 16 percent (GreenTech made in Germany, 2009).

To illustrate the dynamics of the branch, it is enough to note that returns grew at a higher annual rate than 10 percent at 40 percent of the companies surveyed, and this growth dynamic will most likely continue until 2009. The most outstanding growth dynamic, surpassing 50 percent, was achieved by the solar industry.

According to another study performed by Allianz Insurance, there will be an increase in branch turnover from the 60 billion euros in 2006 to 400 billion euros by 2030, which means an annual growth rate of 8 percent (*Heß – Muntzke – Partisch* et al., 2007).

Federal government support for the production of wind, solar and bioenergy and renewable energy resources contributes to the remarkable growth in turnover realised in the environmental industry. Governmental objectives of great ambition, concerning the area of atmosphere protection seem to offer highly promising business opportunities.

"Germany has excellent opportunities to become an influential player on the environmental market of tomorrow" − declared *Sigmar Gabriel*, Federal Minister for the Environment, Nature Conservation and Nuclear Safety, emphasising that German companies already possess solutions to global problems (*Spiegel interview…2008*).

According to the results of the Roland Berger survey, the key areas of environmental techniques from the standpoint of Germany are the production of renewable energy, the amelioration of the efficiency of energy, raw and basic materials, waste and water management. The present world market share of German companies in these domains varies from field to field, ranging from 5 to 30 percent. Presently, the number of branch employees is 1.5 million in Germany. This trend is continuing, the companies involved in the survey are planning an annual 13 percent staff growth between 2007 and 2009. According to the survey made by Allianz, 700,000 new jobs will be created by 2030 in the environmental technology industry and the number of employees in the production of renewable energy will more than double, reaching 330,000.

The global turnover of environmental industry is estimated annually at one thousand billion Euros. This amount is expected to double by 2020. Germany, the leader today, would play the key role in this development trend, leaving the US, the emerging Japan and Australia behind. The largest growth in turnover from German environmental industry products would be realised in Asia, Central-and Eastern Europe. The importance of the Central and Eastern European market would match that of Western Europe by 2020, India, China and Russia will outpace North-America and Japan.

An obvious conclusion to be drawn is that the Hungarian environmental industry would benefit from a strategy of its own for the detection, elaboration, and if necessary, coordination of cooperation opportunities with German environmental protection and technology industry. The successful vehicle manufacturing cooperation between Hungary and Germany can serve as a role model for later initiatives. We have reason to be optimistic, because from the list of perspective branches, visible signs of environmental industry do appear in the strategic documents of some regions − Southern Transdanubia in particular −, in connection with new development objectives ensuring the exploitation of renewable energy resources and safe energy supply. The appearance of this branch of industry is connected to environmental protection, often related to the restructuring of old industrial districts and the recultivation of mining areas. Nowadays, the branch contains activities producing competitive, high demand products requiring know-how, providing the basis of modern industry in some regions. In our days, eco-industry is only represented in waste processing in most regions despite the broad spectrum of eco-industrial development opportunities (*Table 1*).

Environmental protection investments amounted to an annual average of 200 billion HUF in the last five years, constituting approximately 5 percent of the total. More than 75 percent of total environmental protection investments were realised in the form of end-of-pipe investments. One-half of the investments came from the public sector. An annual average growth of 17 percent is observed in environmental protection investments.

According to a survey made by the Central Statistical Office, approximately one half of the investments were made in wastewater treatment, 14 percent were focused on air protection, and similarly, 14 percent were directed at the protection of soil and groundwater.

Eleven percent of the investments were aimed at waste treatment and five percent of the investments were realised in the area of nature and landscape protection. Among the investment areas, the share of wastewater treatment has shown the largest growth since 2004, while the value of investments directed at nature and landscape protection has greatly diminished (Environment Protection Expenditure and Environment Industry, 2006).

Table 1

Environmental industrial sub-sectors and products

Environmental sub-sector	Product type
Protection of air	Air filters, device for gas dispersal enhancement, incinerators, gas recycling systems
Wastewater treatment	Drainage facilities, containers, wastewater cleaning facilities, refrigerated systems, low-pollution technologies
Waste treatment	Waste collection, neutralisation and measurement facilities, recycling equipment, composting and waste deposit facilities, low-level radioactive waste disposal, treatment and isolation facilities, waste equipment and vehicles for waste transportation
Protection of soil and groundwater	Soil protection materials and measurement devices
Protection against noise and vibration	Measurement devices, noise protection devices, sound proof equipment, ceilings, walls, other sound reducing equipment
Protection of landscape and nature	Instruments, materials and equipment for the rehabilitation of flora, fauna, natural habitats, natural and semi-natural landscape

Source: Environment Protection Expenditure and Environment Industry. Budapest, Hungarian Central Statistical Office. 2006.

The territorial distribution of environment investments is quite uneven (*Table 2*). The share of the Central Hungarian region is outstanding, due primarily to the particularly unfavourable position of the Budapest agglomeration in all sub-sectors in EU comparison.

The value of environment industrial sales in Hungary was HUF 306 billion in 2005, approximately HUF 41 billion higher than in the previous year. The largest share was devoted to the production of end-of-pipe pollution abatement goods and services, while the value of the production of integrated environmental protection technologies and products (1.2 percent) was HUF 3.5 billion. Revenues from export sales amounted to HUF 48 billion, accounting for 16 percent of the total environment industrial sales.

Table 2

Environmental protection investments and current environmental expenditure by regions, 2005, million HUF

Region	End-of-pipe investments	Integrated investments	Total environmental investments	Internal current expidenture	Fees paid for bought services
Central Hungary	41,930	20,215	62,145	40,602	34,157
Central Transdanubia	4,846	1,160	6,006	25,581	5,805
Western Transdanubia	3,425	992	4,418	11,387	6,255
Southern Transdanubia	1,784	2,951	4,735	13,351	8,435
Northern Hungary	9,415	650	10,065	27,095	6,457
Northern Great Plains	10,346	1,482	11,829	11,565	6,289
Southern Great Plains	14,746	980	15,725	11,753	5,538
Total	86,492	28,430	114,922	141,334	72,935

Source: Environmental protection expenditure and environment industry. Budapest, Hungarian Central Statistical Office. 2006. p. 16.

IV.

Hungary's EU-accession exerted a positive impact on the quality and quantity of environmental developments. One of its major consequences was the emergence of environmental technology industry. Several initiatives have been launched to support environmental technologies and investments, but the majority of these programmes and measures have not attained the desirable outcome.

According to forecasts, environmental protection expenditure in Hungary will likely double in the next five years. This may lead to an increase in the demand for environmental technologies. It is a non-negligible fact that neighbouring CEE countries will probably undertake the same volume of environmental protection investments in the near future, which will provide a great opportunity for our technology export.

In view of the quality of the domestic environment and infrastructure, the key investment areas will be in the amelioration of wastewater treatment and cleaning systems, and in municipal waste collection and treatment. The estimated amount of investments in the wastewater programme is HUF 100 billion. An estimated investment of HUF 100 billion is required in the renewable energy industry if the country wishes to meet EU energy objectives and fulfil its previous commitments.

It would be beneficial to incorporate the comprehensive development of the environmental protection industry in the reindustrialisation programme of Hungarian regions. It is necessary to elaborate the strategic programme, which, if successfully implemented, will strengthen the income-generating capacity of our regions, create thousands of new jobs, contribute to raising the profile of the Hungarian engineering training, and facilitate the establishment of technological training centres in the large university centres.

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THE RE-EMERGING ROLE OF INDUSTRY IN CENTRAL EUROPEAN ECONOMIES

Gábor Lux

Introduction

Over nineteen years, a significant restructuring has taken place across Central Europe's industrial landscape. The crisis and decline of state-owned industry had initiated a wide de-industrialisation process, transforming post-socialist states into service-dominated economies. Nonetheless, industry has not lost its role in shaping spatial formations, and maintains a leading role in influencing competitiveness. "Post-industrial development" – a process which does not denote an industry-free growth trajectory even in advanced economies – is not yet an option for the majority of Central European regions: there is a need both for the further development of established industry, and the reindustrialisation of under-industrialised or de-industrialised peripheries. In this paper, I briefly discuss the de-industrialisation process that has taken place in Central Europe, with an eye towards its spatial legacy: the various roles industry plays today in different types of regions. Naturally, industrial development is characterised by substantial inertia, where the staying power of previously existing structures, productive and institutional legacies continue to have a long-term effect on current possibilities and future growth opportunities. These questions are explored in the second part, while in the third, I discuss the case of Upper Silesia, Poland, as a successful example of industrial restructuring.

The spatial differences of de-industrialisation

The industrial crisis of post-socialist states was not radically different in its causes and major symptoms from western parallels: however, specific political and economic aspect had made it wider and more severe, while, thanks to its "late arrival", economic policy had to confront the consequences of multiple postponed crises[1]. New decision-makers had to contend with inadequate monetary and political capital (including rising anti-industrial sentiment as a reaction to pollution and the previous ideologies of industrial modernisation), as well as the institutional instability of transition. Consequently, the spatial development of industry exhibited strong continuity in the early 1990s, and transformation brought mainly passive, market-driven change instead of actively managed, policy-driven restructuring. In industrial spaces, the symptoms of the transformation shock included plant closures, a fall in exports due to the disintegration of COMECON markets, reduced output and mass unemployment. Beyond these socio-economic problems, the pressures of lacking or decaying infrastructure, pollution and broader social problems were also apparent.

On the immediate consequences, *Illés* (1994) provides summary data, mentioning (p. 5) that *"in most countries, industrial production became the principal bearer of economic decline; it saw the greatest fall in production, leading to a declining share in GDP. The only outlier in some respects is Hungary, where, in some years, agricultural production fell by more than industry did"*. De-industrialisation was accompanied by the concurrent rise of the service sector, tertiarisation. The decline of industry was different among states, and exhibited further differences on the sub-national level. Focusing only on the change of employment between 1991 and 2004, we can delineate three country groups: the Czech Republic and Slovakia, where reduction was not significant; Poland, Hungary, Slovenia, Croatia and Macedonia, where it amounted to 20–30%; and south-eastern states where it approximated (and in the case of Romania, exceeded) 50% (*Table 1*).

The relevancy of national differences becomes even more significant if we examine qualitative factors behind the global numbers, and consider how de-industrialisation/tertiarisation plays out on the regional level. In this respect, we can speak of the broader tertiarisation process as an aggregate of three different trajectories: at the same time, it means a correction of the economic structure; a modernisation process; yet in some cases – often left undiscussed in publications analysing transition – it is also a symptom of industrial loss, a sign of economic weakness. It is a significant feature of transition that while the first aspect of tertiarisation can be applied generally to socio-economic space, the second and the third manifest in centre-periphery arrangements, and lead to the increase or reinforcement of spatial differences.

As a *correction of the economic structure*, the case of tertiarisation is relatively clear-cut: socialist economies possessed "oversized industries" (as statistically demonstrated in *Winiecki* 1986), while the service sector was kept artificially underdeveloped, in part by putting restraints on domestic consumption, and in part due to the fact that in the economic system, bureaucratic coordination took the place of markets (*Kornai,* 1980) and there would be no room for the traditional understanding of business services. From this perspective, the emergence of the service sector after 1990 can be seen in a positive light, as the end to an unnatural state of being.

Table 1

De-industrialisation in Central Europe, 1991–2004

Country	Industrial employment in 1991	Industrial employment in 2004	Industrial employment in 2004 (1991=100)
Albania	242,489	127,000	52
Bulgaria	1,785,000	967,900	54
Croatia	694,700	469,000	68
Czech Republic	1,958,876	1,844,400	94
Hungary	1,349,369	906,299	67
Macedonia	260,000	190,355	73
Poland	5,483,100	3,509,917	64
Romania	4,512,000	2,173,671	48
Serbia and Montenegro	1,307,100	650,518	50
Slovakia	848,859	846,000	100
Slovenia	429,300	342,700	80

Source: Author's calculations and construction based on national statistical yearbooks.

Tertiarisation is also a *modernisation process*. The explosion of services mostly occurred from the 1960s and onward in Western European economies, followed with some delay by the states of the southern periphery. The rapid spread of modern service functions is also visible in post-socialist Central Europe, with the caveat that this spread is hierarchical (*Nemes Nagy,* 1998), manifesting first on the peak of the settlement hierarchy (i.e. national capitals), and only gradually expanding to lower tiers. The dominance of major urban centres in service-based growth, especially considering the lower overall urbanisation level of Central Europe in comparison with western parallels, remains a barrier before the most positive effects of tertiary modernisation. In general, the more innovative, modern or "valuable" a service (e.g. banking, infocommunication, financial services), the more strongly it is concentrated in space (for examples, see *Horváth,* 2007 and *Gál,* 2005); furthermore, it must remain a cautionary note that in Central Europe, even the most advanced service centres, capital cities are only low-ranking contenders in global competition.

The third interpretation of tertiarisation is less positive. In peripheral areas, the high share of services is not a sign of economic power and modernity; rather, a *symptom of weakness and underdevelopment* – i.e. a lack of competitive economic alternatives. Individuals, households and communities turn to service activities for self-sustenance; their overriding motivation is not competition but survival. Naturally, even within this interpretation, there are considerable differences: examples range from the relative benign (e.g. towns and cities capitalising on their past and urban values to reinvent themselves – for the case of Pécs, see *Bakucz* 2007 and *Lux* upcoming) to the disastrous (e.g. cities, regions and entire states that have undergone a wholesale industrial collapse – *van Zon* 1998, *De-industrialisation and its consequences. A Kosovo story,* 2002).[2] It is a sobering example that in Hungary, the highest rate of tertiary employment in 2006 on the NUTS-3 level was in Pest county (77%), but this was immediately followed by relatively underdeveloped ones, including country's poorest peripheries. Conversely, the forerunner counties outside the capital, Győr-Moson-Sopron, Fejér and Komárom-Esztergom, boasted a relatively low share of employment in services, with Komárom-Esztergom at the lowest (48%).

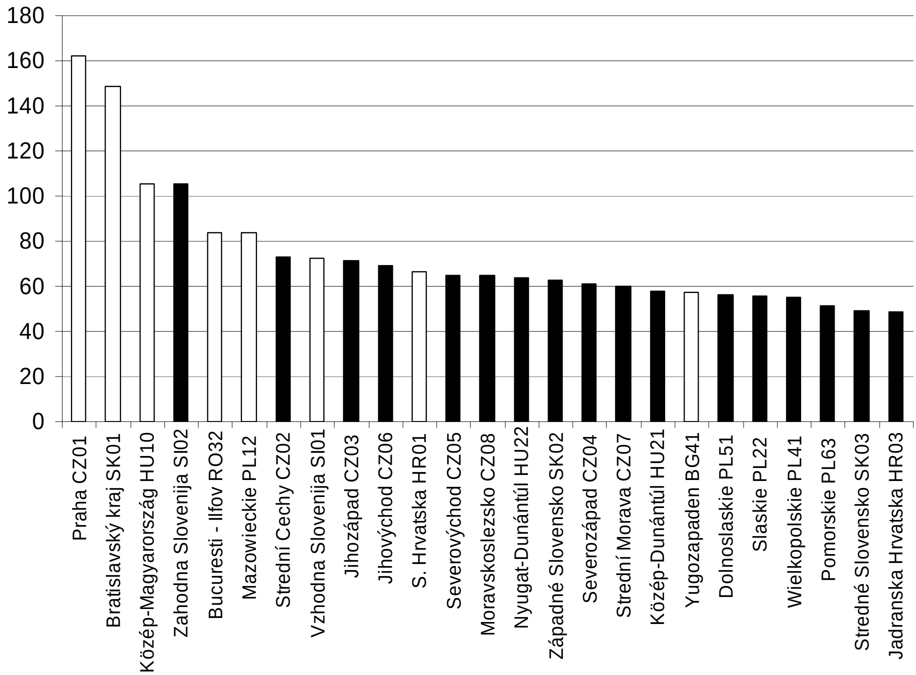
The persisting significance of industry in spatial differentiation is further demonstrated by Figure 1. In the Central European ranking of per capita GDP, the first positions are occupied by capital regions with a highly tertiarised economy and a diverse range of high-value-added services. However, non-capital regions on the list provide a more ambiguous picture – while the majority of their employment is found in services, their economic output is strongly tied to industrial production. In fact, the possibilities of successful industrial restructuring are shown by the relatively high ranks achieved by some Old Industrial Regions which had been written off as "hopeless": Central Transdanubia, Moravian Silesia, Upper Silesia but also the region of Pomerania with the Gdansk – Gdinya – Sopot urban triangle. It would be a simplification to say that these regions are problem-free or already beyond restructuring (in fact, this could not be said even of the Ruhr or the British Midlands) – but while they were "losers of systematic change" (*Gorzelak,* 1998), they are not automatically losers of the entire post-socialist transformation process.

As a consequence of the previous theses, I advocate a differentiated understanding of industry in Central Europe on the basis of the role it plays in three different region types: central, intermediate and peripheral regions. *Central* (capital) *regions* were major industrial hubs during, but also before state socialism; since then, they have lost the majority of their production bases. Nevertheless, it remains relevant for economic and especially regional policy that if not in production, these regions still occupy leading positions in management, supporting services, R&D as well as higher education in technical and natural sciences. Some industrial activities with a high innovation and knowledge content have even maintained footholds in production – biotechnology, pharmaceuticals, precision mechanics and some other leading branches.

Intermediate regions, which could be described as winners of the transformation process, have been the major beneficiaries of industrial Foreign Direct Investment; both in the establishment of new industries and the renewal/modernisation of old traditions. As seen in the next part of the paper, they could successfully exploit the positive effects of continuity: a relatively strong institutional network, the availability of an adequately skilled labour force, and the gradual establishment of business services in support of industry. Although the crisis of the global economy has lead to a reduction in the output, employment and exports of some of the more successful industrial branches of intermediate regions, it is unlikely this will be a long-term hurdle. What matters more is the supporting structures that encourage the continuous renewal and adaptability of industrial networks, not their precisely defined contents – in particular, skilled and flexible labour is going to be a growing concern of future decision-makers, as well as the stronger local and regional embeddedness of existing industrial activities via clusters and production networks.

Figure 1

The top 25 Central European regions ranked by per capita GDP, 2006, PPP, % of EU-27 average



Note: White columns indicate service-based central regions; black columns indicate intermediate regions, whose growth is primarily based on manufacturing.
Source: Author's construction based on data from Eurostat.

Traditional (under-industrialised) and *new* (de-industrialised or industrially collapsed) *peripheries* must contend with the consequences of an economic crisis which has grown into a broader and more insiduous socio-economic problem. Their main issue is the weakness or loss of useful background knowledge and institutions: in their case, the crisis of old industries has already concluded, but it has resulted in a low, socially unacceptable level of stabilisation. The wider social implications are outside the scope of this paper; however, if reindustrialisation policies are to be undertaken in these regions, they must be accompanied by comprehensive social regeneration measures before market actors become interested in investments. Even semi-peripheral industrial branches that focus more on employment than competitiveness can have a stabilising or rejuvenating effect, although in the more severe cases, even providing the basic input of unskilled or semi-skilled labour can prove a challenge.

Surviving structures: the role of continuity

In discussions of post-socialist industrial development, it is common to emphasise change; the visually striking contrasts between old and new industry. Although transformation has indeed resulted in the reconfiguration of cities and regions, the survival and long-term adaptation of inherited economic structures, institutions and even cultural patterns cannot be neglected in discussing industrial change. Studies on the causes of industrial crises (e.g. *Steiner* 1985, 2003, *Grabher* 1997a–b or *Boschma – Lambooy* 1999) often employ the concept of *path-dependency*; that is, the tendency of industrial regions to be locked into development paths set by their pre-existing traditions, resulting in an inability to adapt to changing economic conditions, and consequently facing ever worse economic shocks. However, path-dependency can also be seen in a more favourable light, and involve the transfer of positive traditions, productive cultures, organisational solutions and institutions. In the industrial transformation of Central Europe, both the positive and negative understanding of path dependency can be observed.

The spatial structure of industry shows the strong overall de-industrialisation process, but also the survival of national and trans-national spatial structures (*Figure 2*). Between the early 1970s and the EU's 2004 enlargement, de-industrialisation had taken place in all surveyed areas: in 2004, only three regions out of 60 had an employment level exceeding 50%, while in 1971 (granted, on a finer spatial scale), almost one half, and in 1991, a quarter of them fell into this category. On the other hand, traditional industrial divides survive: in Hungary, the northern "industrial axis" still has the largest national share of industrial employment, while Poland's south-western regions, Slovakia's west-east industrial gradient, or the industrial concentrations of South Transylvania, Banat and Bucharest also remain dominant. In fact, there are striking overlaps between the traditional and new core of Central European industry: the former, demarcated by the Łódz – Erfurt – Budapest triangle and going back to before World War One (*Enyedi* 1978), has re-emerged in the form of the latter, the new transnational growth zone preferred by FDI-based manufacturing in our time. The association is not coincidental. Favourable geographic location undoubtedly played a role in encouraging the integration of industry in the proximity of western markets and benefiting from good infrastructure. But the positive path-dependency of these favoured areas cannot be neglected either: the successful adaptation of industrial complexes and networks with long historical traditions was a crucial component of the growth that had later benefited from Foreign Direct Investment: in the case of Hungary, the examples of Győr and Székesfehérvár, with industrial milieus going back to the Monarchy and inter-war military industry development, respectively, are good examples of the phenomenon.

Figure 2

The share of industrial employment (1970–1971, 1990–1991, 2003–2004, %) and industrial core areas

Source: Author's calculations and construction based on national statistical yearbooks.

The successful survival of industrial structures is mostly a result of three factors. First among them is *favourable production factor supply*: production factors, especially skilled labour, available in relative abundance and at advantageous (although not necessarily the lowest) prices, preferably with organised channels of supply. Human capital's significance has arguably approximated or even overtaken that of simple transport accessibility since the turn of the millennium, and is expected to increase in the future. Its source is partly endogenous, partly resulting from internal migration, often from "skimming off" of industrial crisis areas in the 1990s. Research by *Barta – Czirfusz – Kukely* (2008) has indicated that it is above all medium-skilled labour and activities that have overwhelmingly appeared in Central Europe since 1990, to the detriment of both branches employing unskilled labour (which are facing the threat of delocalisation and fierce competition from the Far East) and those involved in high-skill industry (which were often downsized by foreign and domestic owners in the early 1990s under survival or market-acquisition-oriented corporate strategies, and were not replaced in great numbers afterwards – for a critical examination of the process in Hungary, see *Gazdag,* 2009). It is notable, however, that even the presence of medium-level industry to the de-industrialisation of the peripheries; the loss in human capital that has taken place in these areas raises obstacles before later reconstruction, while regions where even a low level of industry survives typically find it easier to develop or attract new profiles.

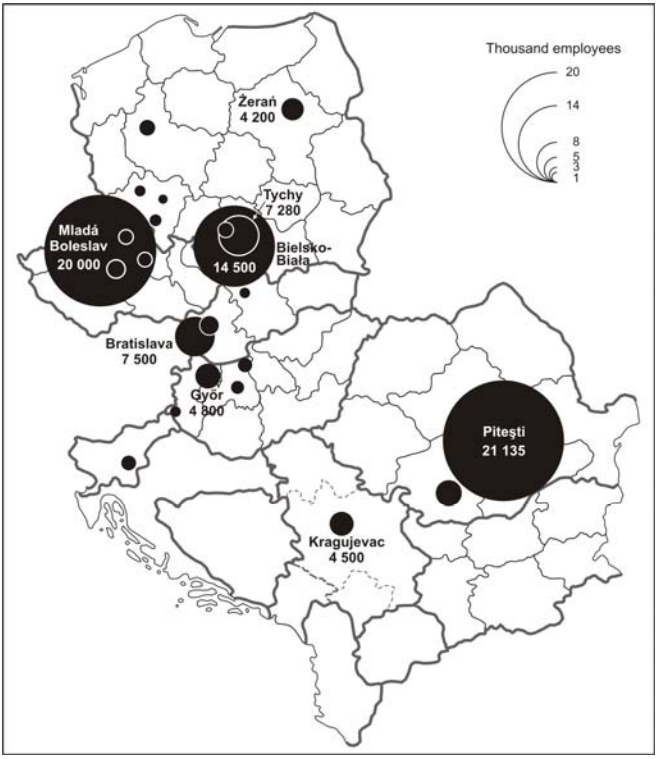
The second factor is the regional *institutional background*: a collection of "soft" production factors contributing to the stability and development of industry. This may mean formal organisations (economic chambers, promotion agencies, local governments, etc.) as much as the informal cooperation of economic stakeholders (development coalitions, interest groups, etc.), or a broader social background encompassing education, training, entrepreneurship, and even less tangible cultural elements. Institutional factors, although hard to quantify, have a demonstrable effect on the success of adaptation; their development, although heavily tied to long-lasting legacies, should be a foremost concern of local–regional elites.

The third factor, *adaptability* shows a strong correlation with the institutional sphere, but the relation should not be understood as deterministic. In essence, what matters is how a region, or a smaller milieu can "re-imagine itself" by balancing path-dependent development (and trying to capture its positive aspects) with flexibility to change. In Central European space, adaptation since 1990 has mostly occurred via passive structural change, and conforming to situations posed by external forces: even successful regions fall into this category. It is much rarer to see innovative, endogenous responses to the question of industrial renewal (although they have been relevant in some cases, especially that of Slovenia), and it is likely that as long as the low availability of capital and knowledge in post-socialism persists, no major change will take place.

The survival of spatial structures in industry can be seen in general terms (e.g. Figure 2), but the location patterns of specific branches may be even more striking. Figure 3, showing the spatial distribution of employment in automotive industry, shows the strength of previous manufacturing centres of leading domestic car brands quite clearly, and also that even newly opened production facilities can be tied to pre-existing machine industrial bases.[3] Industrial location shows even finer differences: research by *Domanski* (2003, 2004) demonstrates an urban–non-urban split between capital- and labour-intensive industrial production in Polish industry, while *Grosz* (2006), exploring the formation of a Hungarian automotive industrial cluster, has found a network of sites with a variety of tighter and looser interrelations based on proximity to the cluster's core and ties to the urban network.

Figure 3

Employment in automotive industry, 2003



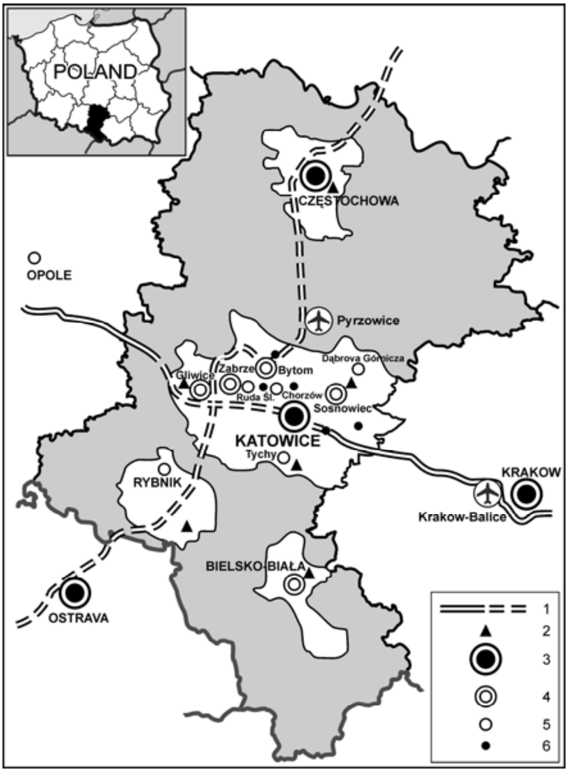
Source: Author's construction based on data from Worrall – Donnelly – Morris, 2003.

Upper Silesia: an example of successful adaptation

Regions with a tradition of coal mining and metallurgy are iconic spaces of industrial restructuring, and they have typically seen the strongest economic, social and environmental consequences of the crisis: the Ruhr or the Midlands in Western Europe as much as Borsod, Košice or the Jiu Valley – Hunedoara in post-socialist states. Upper Silesia may be reasonably included in this group: its industrial growth and urbanisation had already been spectacular in the 19th century, and as a favoured area under state socialism with large-scale investments into production and housing, it could further increase its special status in the spatial structure of Poland (the united region has 3.7 million urban residents out of 4.7 million total, of whom 2.8 live in the Katowice conurbation – c.f. Figure 4). As in other post-socialist Old Industrial Regions, the decline of industry had already preceded systemic change: between 1980 and 1990, 185,000 workers had left the ailing coal mining sector, and similar processes had taken place in the steel industry.

Figure 4

The location and urban network of Upper Silesia



Legend: 1 – motorway (existing/planned), 2 – sites of the Katowice Special Economic Zone, 3 – cities over 250,000 population, 4 – cities with 150,000–250,000 population, 5 – cities with 100,000–150,000 population, 6 – cities under 100,000 population.
Source: Author's construction.

Inheriting serious problems and a distorted economic structure with a high prevalence of technologically obsolete plants, the first years in the transformation of

Upper Silesia were – similar to Western European crisis areas – characterised by measures intending to retain jobs and provide social relief (*Cymbrowski,* 2004). In spite of pessimistic expectations, however, the region did not lose its industry to the degree it was predicted, and has arguably started to recover from the second half of the 1990s. The *development coalition* of the new decisionmaking elite, consisting of politicians, the representatives of local governments as well as economic stakeholders including chambers, businessmen, etc., have become bearers of bottom-up development initiatives, and have been able to represent regional interests even in opposition of central authorities, becoming key supporters of the Polish regionalisation process. The success of restructuring policies has been strongly advanced by the process of institution-building, which resulted in a range of development agencies and corporations with a focus on industrial restructuring, business promotion, as well as infrastructural and regional development. These changes were instrumental in the establishment of the 1995 *regional contract*, which regulated the division of tasks and competencies between the central government and the voivodship (then extending to only the central part of the current region). Although the contract has been criticised for giving too much leeway to central decision-makers (cited by *Bierwiaczonek – Zagała,* 2004), most commenters have nevertheless emphasised its innovativeness, and its role in strengthening regional institutions and preparing them for the reception of EU funds, which they have been involved in distributing since accession.

The restructuring of Upper Silesian industry proceeded along two main directions; adaptive restructuring through renewing old branches, and reindustrialisation through attracting new ones. In coal mining, the downsizing of the oversized labour force and mine closures were only undertaken gradually, using World Bank funds in the second half of the 1990s to offer early retirement opportunities with a generous severance. Some of the remaining mines are now operating with profit, although all but one of them have so far remained in state ownership, and production has shifted from Katowice towards the richer deposits of the Rybnik agglomeration. In the steel industry, changes occurred more swiftly, with early downsizing and focusing on capturing new markets in the EU and the Far East. In the product structure, the proportion of low value-added products has decreased in favour of special steel products; some of them manufactured by an emerging cluster of smaller producers operating around the larger steelworks. Some plants with outdated technology have been closed, the others have been acquired by domestic or international investors; the largest steelwork, Huta Katowice, going to ArcelorMittal, the world's leading steel company.

Starting with 1995, the main instrument of reindustrialisation was the creation of *special economic zones* to attract Foreign Direct Investment. The Katowice Special Economic Zone, which is divided into four sub-zones, has become the most successful in Poland with regards to both attracted capital (exceeding € 2 billion) and employment (exceeding 25,000). Investors have mostly targeted automotive industry, which has had traditions in the region going back to 1975, but also other branches including ceramics, glass, food industry and beverages (http://www.ksse.com.pl). Although, similar to other Polish regions, Upper Silesia's transport infrastructure is below its needs, it has become an attractive investment location due to the favourable supply of skilled labour: this advantage derives from the strong system of technical schools, as well as higher education in the technical and natural sciences. With the exception of coal mining (a special case in both Western Europe and post-socialist states), workers from downsized industries could be directed into new branches with considerable success, and the region largely avoided the massive loss of human capital that has occurred elsewhere. The embeddedness of foreign investors has been encouraged by the existing regional institutional network; and while the tax benefits offered by the special economic zone have become untenable after EU-accession, the region remains attractive before further investment.

On a final note, the development of the region's metropolitan functions deserves mention: linked in part to industry, business services have taken off, primarily in banking where four large banks maintain headquarters in the region vis-à-vis Warsaw (e.g. ING Bank Sląski), and several others have a local presence; higher education, with three larger universities and a number of colleges, contributes to the quality of the labour supply with a total of 100,000 students. The fragmentation of city administration, a growing concern for the Katowice conurbation, is intended to be alleviated by the Upper Silesian Metropolitan Union, established Summer 2008 with 18 founding members as much as to coordinate development activity and interests as to efficiently attract and manage EU funds.

It is questionable to what degree the example of Upper Silesia may be generalised with respect to Central European industrial development. Some of its features are unique among Central Europe's non-capital regions, first and foremost of them the critical mass of urban residents and institutions. However, the example of regional interest articulation and institution-building on the basis of subsidiarity is deserving of mention, and becomes especially apparent in comparison with the development of Ostrava, on the other side of the Polish – Czech border. While Ostrava had a rather similar economic profile before 1990, due to the more centralised nature of the state, but also the weakness of bottom-up organisation on the regional level, institutional changes were missing or more meagre, and consequently, the restructuring of older industries occurred in a more centrally directed manner, with the deep decline of traditional branches and symptoms of the more destructive form of tertiarisation discussed previously in this paper. The Ostrava agglomeration, as well as the Moravian

Silesian region, could not effectively counteract these processes due to the weakness of mobilising endogenous will (for a detailed examination, see *Sucháček,* 2005a–b), and although it enjoys a favourable position in Central Europe, it has become the least developed region of the Czech Republic.

Conclusions

It is a central thesis of this paper that even in the long term, industry will remain a key factor of regional competitiveness in Central Europe. In national capitals and potentially a number of large cities, opportunities for more service-based growth will dominate, but outside them, industry may not be neglected on either the national or sub-national level. The development of industry is a long term process, with strong backwards links to inherited factors. The factor supply of regions (primarily their human capital), their institutional networks, and also their adaptability will become key issues of further success or the lack thereof. In the current state of the world economy, these issues, particularly the third, can be expected to gain even more prominence. Recession is a fact, but the ultimate outcome of the crisis depends heavily on how a region can retain, and if needed partially redefine its industrial heritage. The adaptation of industrial cultures, and new, innovative strategies building on previously unexploited endogenous resources may be the most effective; while Foreign Direct Investment will remain a core element of Central European industry, its supply will be less abundant and more attention will need to be paid to the questions of embeddedness and local – global links to stave off the threat of delocalisation. Increasing the added value of industrial production, and the development of human capital will also have to figure into the emerging industrial landscape of the next decade.

Notes

[1] For a general estimation of the growth costs of impeded industrial restructuring, see *Audretsch et al* 2000.

[2] It deserves mention that in a number of South-East European states, the agricultural sector has played a role in absorbing those who had lost their jobs in industry (*Kovács* 2003); this is not typical elsewhere.

[3] On the other hand, the figure may not be considered a completely accurate representation: it does not differentiate between labour-intensive and capital-intensive production, neglects to explore broader supplier networks, and reflects the 2003 situation: it is an illustration more of a general phenomenon than the exact geography of Central Europe’s automotive industry.

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THE ROLE OF ENVIRONMENTAL INDUSTRY IN SUSTAINABLE ECONOMIC DEVELOPMENT

István Fodor – Andrea Suvák

Environmental industry has received much attention in the past three decades. Beyond the growing consciousness of environmental harm imposed on nature by industrial processes, this has largely been generated by the necessities of economic growth and global trade. However, increasing emphasis has been laid on technical solutions that exceed traditional clean-up technologies to tackle environmental damage and to achieve greater benefit to natural environment.

Defining environmental industry

Environmental industry is a manifestation of attempts to eliminate environmental strains induced by the modern production-consumption system. The literature on ecological industries uses a handful of co-existing expressions and definitions for this sector. The expressions "ecological industry", "eco-industry", "environment industry" and "environmental industry" all refer to the same sector, although the approaches have some slight differences in their details or classifications, and have evolved over time.

The most referred definition of environmental industry is given by the OECD-Eurostat (1999). Following this definition, "the environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources" (OECD, 1999). It is worth to note that the first document that attempted to measure this sector, published by the OECD in 1992, did not include cleaner technologies as a part of the eco-industry. Cleaner technologies were included within eco-industries in the 1994 definition of the European Commission (*Barton*, 1997). The 1999 OECD document makes a classification of the environmental industry along two dimensions: environmental goods and services *classes* and *business activities* (see *Table 1*). Environmental goods and services (EGS) are classified into three main groups: pollution management, cleaner technologies and resource management. The corresponding business activities include production of equipment and special materials, provision of services and construction and installation of facilities.

Table 1

OECD classification of environment activities

Business activities	production of equipment and special materials	provision of services	construction and installation of facilities
Environmental goods and services classes			
Pollution management group			
Air pollution control			
Waste water management			
Solid waste management			
Remediation/clean-up of soil and water			
Noise/vibration abatement			
Monitoring, analysis, assessment			
Cleaner technologies and products group			
Resource management group			

Source: OECD, 1999.

The pollution management group provides goods and services with a clear and exclusive environmental purpose, and that contribute significantly to the reduction of polluting emissions. Cleaner technologies and products embrace goods and services that reduce or eliminate negative environmental effects during the processes of production and consumption. Cleaner technologies can be distinguished as they seek to *reorganise* the whole production process (*Barton,* 1997). Resource management refers to activities that have a positive impact on the environment, although they principally serve other purposes (e.g. efficiency gain).

As Barton (1997) puts it, “the environment industry is centred around the production of pollution control equipment and waste treatment disposal” (*Barton,* 1997). In his understanding, cleaner technologies are not included in environment industry due to their different approach. Barton establishes nine sub-divisions within eco-industry:

- waste management,
- wastewater treatment,
- air pollution control,
- energy management,

- marine pollution control,
- environment monitoring and instrumentation,
- environmental services,
- noise and vibration control,
- contaminated land remediation.

In a recent document by the German Ministry for Environment, Natural Protection and Nuclear Safety a definition similar to that of the OECD can be found: "environmental industry comprises enterprises that offer goods and services to reveal, minimize and eliminate environmental strains (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2006). This document reckons the following branches among environmental industry activities: waste management/recycling, water protection/wastewater treatment, air pollution control, noise reduction, renewable energies and efficient energy use techniques and climate protection. Concerning the technological classification, the German federal environmental authority differentiates between *integrated environment protection*, i.e. production processes that inherently produce smaller emission outputs, as well as nature-friendly products, and *additive environment protection* (analogous to end-of-pipe techniques in the Anglo-Saxon literature) for the elimination of already existing harmful emissions.

A 2006 report of the European Commission states that cleaner production is a subordinate category of pollution management, whereas the latter embraces principally end of pipe technologies. However, uniquely among the above presented works, the EC report includes environmental research and development within the array of the industry branches, as well as general public administration (European Commission, 2006).

The dichotomy of end-of-pipe technologies and clean technologies (integrated environment protection) is apparent in the literature of environmental industries. For the comparison of business considerations of end-of-pipe techniques and cleaner technology, see *Table* 2.

Some authors argue that cleaner technology solutions result in efficiency gains and increased profits while end-of-pipe techniques are likely to raise production costs (*Triebswetter and Wackerbauer*, 2008; *LukenFreij*, 1995). Others state that costs incurred by end-of-pipe equipments make up only a negligible part (2–3%) of the total production costs and they are minor compared to e.g. labour and raw material prices (*Jaffe et al.* 1995; *Duchin et al.*, 1995).

Jha states that "if environment performance indicators were taken as an indicator of environmental end use, environmental goods would be restricted to only a few categories of products, including environmentally-preferable products (EPPs), natural risk products, renewable energy, waste management, clean up, and waste and portable water products" (*Jha*, 2008).

Table 2

Comparison of end-of-pipe and clean technologies

Economic parameter	End-of-pipe technology	Clean technology
Total productivity	Decrease of productivity	Potential for productivity increase
Production costs	Increasing	Potential for cost reduction
Investment need	Lower	Higher
Sunk costs	Generally: no	Potential
Information and access costs	Lower	Higher
Adaptation costs	Lower	Higher
Compatibility with current production methods	Higher	Lower
Economic risk	Lower	Higher
International competitiveness of the economy	Tendency: negative influence	Potential for future competitive advantages

Source: Coenen et al. In: Triebswetter and Wackerbauer 2008.

Eco-industry is a diverse sector, with numerous linkages to other industry branches. Many of the fundamental reports and works on environment industry notice that neither the environmental goods and services, nor the circle of the enterprises within this sector can be exhaustively identified (*Barton*, 1997; OECD 1999, Bundesministerium, 2006), because many of the goods can be used for non-environmental purpose (e.g. pumps), and the majority of the firms are also engaged in different industrial activities (*Triebswetter and Wackerbauer*, 2008). Consequently, the quantification of this sector has always been a pivotal question. According to the 1999 OECD report, when measuring environmental industry, all principal, secondary or ancillary activities of firms should be considered if they represent a *significant* production of environmental goods or services.

History and background

The late '60s and early '70s brought a shift in the environmental thinking of the industrialized world (*Jaffe et al.*, 1995, *Schmidheiny*, 1992). The first decades of environmental protection can be described with three stages of evolution (*Buday-Sántha*, 2002). The first and worldwide astonishment on environmental issues was induced in the '60s by the discovery that chemicals, commonly used in agriculture or pharmacology, contain non-degradable compounds that accumulate in the human organism, causing serious harm to health. Parallel to this, intense industrial pollution elicited growing environmental concern among local people exposed to such levels of contamination. It was also revealed that local pollution can cause natural harms on different parts of the globe. This period can be called the time of astonishment. The '70s marked an era of official acknowledgement and institutionalization of environmental protection. Many countries established their environmental agencies and legislation parallel to the development of international environmental organisations. A number of major conferences on environmental issues were held and international environmental agreements were reached (Stockholm Conference 1972, London Treaty 1972–73). In the '80s and '90s the series of international agreements continued. In general, they targeted emissions reductions within 5-15 year time-spans (Helsinki Treaty 1985, Vienna Treaty 1985, Montreal Treaty 1987, Sofia Treaty 1988, Basel Treaty 1989, Geneva Treaty 1991, Rio Conference 1992, Oslo Treaty 1994, Kyoto Conference 1997). Such international conferences can be characterised by a strong conflict between industrialized and economically underdeveloped countries, as well as between ecological and economic interests. Developing nations rejected the concept of freezing uneven industry based development across the globe, while business representatives held that rigorous environmental regulation would hinder economic development (*Buday-Sántha,* 2002). Nevertheless, growing international awareness resulted in tighter regulatory systems throughout the world which led to the emergence of a novel economic branch, the industry of environmental goods and services (*Barton,* 1997).

Environmental regulations were first put into force in the 1970's (*Barton,* 1997). Many of the commentators stress the importance of regulation in the development of environmental industry and further as a stimulus for continuous environmental innovation (*Triebswetter and Wackerbauer,* 2008; *Duchin el al.,* 1995). It is also noted that stricter environmental regulations in many cases resulted in the relocation of 'dirty' industries and polluting processes into developing countries (*Jänicke et al.,* 1997; *Barton,* 1997) that due to their subordinate position in global economic processes were obliged to attend the needs of foreign investor firms.

First enterprises in the sector of environmental goods and services were generally publicly owned companies that supplied public infrastructure services (potable water, waste management, wastewater treatment). Private sector environmental industry first emerged as in-firm activity when companies produced pollution abatement equipment for their own use (*Duchin et al.,* 1995). Initially, small and medium-sized companies were dominant to supply the market, but after the '90s they were replaced by firms of larger size (*Barton,* 1997), later by multinational companies. International rhetoric stressed that environmental industry was needed for developed countries to lessen their ecological footprint via more effective production methods, while in developing countries the goal was to transform heavily natural resource based economies to more industrial but at the same time more input efficient ones, with the assistance of environmental industries (*Yu,* 2007). After heavy negotiations on world trade forums (especially the Doha round of WTO in 2001) agreed to dismantle the market barriers of environmental goods and services, the newly opened, underserved markets of the developing and emerging economies were promising high market gains for the large and already established market players of the United States, Western Europe and Japan (*Jha,* 2008; *Kennett and Steenblik,* 2005, *Vikhlyaev,* 2003). At the same time developing countries feared that their export activities would be inhibited by stringent environmental regulations the attendance of which would have raised costs considerably (*Wysokinska,* 2005; *Barton,* 1997).

When environmental goods and services proved to be a growing market, promising a potential for growth for post-industrial economies, it was not surprising that eco-industry became a major issue on international trade and policy debates (*David and Sinclair-Desgagné,* 2004). The role of regulations was an important factor at the early evolvement of the international environmental market. Despite the traditional neoclassic fears that strict environmental regulations would hinder economic growth (*Palmer et al. In: Triebswetter and Wackerbauer,* 2008), environmental regulation proved to be a driving force of economic development in many countries, typically in Germany, the Netherlands, the United States and Japan, that were early in urging environmental regulation (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit 2006; *Jha,* 2008). These countries became first movers in the market of environmental goods and services, gaining a significant advantage in terms of technology and market share. The regulation of ‘dirty’ industries led to the development of end-of-pipe technologies in the ‘80s, while the ’90 brought a shift towards clean technologies. First, mover position in the sector established market advantages prevalent to date. The U.S. first gained advantage in waste management, in Europe waste-water treatment was the strongest branch while Japan had an important role in the production of air-pollution control equipment (*Barton,* 1997).

Among the array of regulations, flexible policy instruments and take-it-or-leave-it offers proved to be a greater incentive for firms than pure command-and-control measures (*Triebswetter and Wackerbauer,* 2008; *David and Sinclair-Desgagné,* 2004). To keep a leading position in the global competition and to comply with the rapidly evolving environmental regulations, the firms in the environment sector rely on R&D heavily (*David and Sinclair-Desgagné,* 2004).

Environmental goods and services on global scale

The global market for environmental services was estimated to be worth $200 million in 1990 (OECD 1992 In: *Duchin,* et al. 1995). The major players of the market were the United States, Germany and Japan, accounting for more than 90% of the OECD output of end-of-pipe products (*Luken and Freij,* 1995). Germany was swift in introducing new standards in the '80s and with heavy investments on R&D (3.1% of turnovers compared to 1.8% in manufacturing generally) the environment sector soon became a strategic sector of the country, dominating with 36% of the EU share in the early '90s. Forty per cent of the production was put to export markets in the '90s (*Barton,* 1997).

The market for environmental goods and services is to date still dominated by the U.S.A. (American industry controls 37 per cent of the market), Western Europe (30%) and Japan (18%) (*Jha,* 2008). By 2005 the global environmental industry was estimated to have grown to $607 billion with these three countries accounting for 84% of it (*Yu,* 2007). The market of the European Union was over $18 billion at this time (*Jha,* 2008). Environment services segment made up more than 50% of the total market in the mid 2000s. In OECD countries the public and private ownership have and equal share while in developed ones public sector accounts for approximately 70% of total environmental expenditures (*Vikhlyaev,* 2003).

The growth rate of the industry in the United States was 14% between 1996 and 2000, while 1.5% in 2000 and 2001. During the same period, developing countries experienced growth rates of 7–8% yearly. The market is expected to grow further with rates between 8 and 12 per cent in developed countries (*Wysokinska,* 2005). The market of the Asian environment market (excluding Japan) was estimated to be worth $37.5 billion in 2005, making up 6% of the global market. Growth potential was predicted 9% till 2010 (*Yu,* 2007).

Growing capacity in developing countries is mostly based on partnerships with established foreign firms but also on the demand of the domestic markets. There is little evidence that this growing capacity appears in exports as well (*Vikhlyaev,* 2003). Environmental trade in developing countries is contradicting in a sense that trade in EGS is restricted only to a few countries and not all the environmental 'hot spots' are served. The main reason for this is the lack of a viable market and purchasing power (*Jha,* 2008). The total global market of EGS is expected to have grown to $705 billion by 2010 (see *Table 3*).

When environment services leaped into a mature stage facing the slowdown of market increase, the leading countries sought export possibilities at markets with high growth potentials (*Sawhney,* 2006). Market expansion was assisted by the common ascertainment, prevailing since World War II, that the maximization of economic growth can best be attained by global liberalization of trade and that economic growth is “the fundamental objective of the world system” (*Duchin et al.,* 1995, p. 185). Imposing environmental standards and regulations on developing countries shortly lead to the corresponding technology transfer and export of equipments from market-leader developed countries to less developed ones. The United States, Western Europe and Japan have competed aggressively to gain market shares in Latin-America, Eastern and Southern Europe and the rest of Asia accordingly. Market penetration has been fostered through a standard-setting strategy, which was enforced for example at new entrants of the European Union by a non-negotiable free trade clause to accession agreements (*Jha,* 2008). In Asian developing countries the most promising sectors are wastewater treatment and solid waste management services with their corresponding equipments, along with air pollution control goods (*Yu,* 2007). These countries rely heavily on imports (*Table 4*).

Table 3

Global environmental market 2000–2010, USD billion

Region	Actual*						Fore-casts
	2000	2001	2002	2003	2004	2005	2010
USA	210.5	215.2	221.4	227.5	233.7	240.2	275.1
Western Europe	157.8	160.8	165.0	169.1	173.4	177.7	201.0
Japan	93.7	93.3	92.4	92.6	92.9	903.1	94.4
Rest of Asia	24.0	25.6	28.2	31.0	34.1	37.5	66.1
Australia/NZ	8.4	8.6	8.8	9.1	9.5	9.8	11.7
Other region	47.6	48.5	45.4	46.6	47.8	49.1	67.6
Total	542.0	552.0	561.1	575.9	591.3	607.4	705.3

* Data for 2000-02 are reported by industry, and the rest estimated based on trend.
Source: Sawhney, 2006.

The trade flows of environmental goods and services continue to have a clear North-South direction (*Barton,* 1997; *Yu,* 2007). At the same time, influential environmental goods exporter countries seem to be determining players on the import side as well (*Table 5*). Many of the developing countries are having financial constraints in providing state-of-the-art communal services (*Sawhney,* 2006; *Barton,* 1997). This has led to rapid privatisation and liberalization of essential communal and environmental services in the 1990’s, often with the result of state owned departments being left with financial deficit when the short-term contracts terminated and the investors moved out of the country. Such evidence in developing Asian countries implies that stricter regulatory policies are needed in the process of liberalizing environmental services (*Sawhney,* 2006).

Table 4

Latin American environment markets and imports, 1992

	Market (US$ mill)	*Percentage imported*
Argentina	168	25
Brazil	1,015	19
Mexico	614	24
Venezuela	44	97
Chile	560	89
Colombia	45	78

Source: Barton, 1997.

Table 5

Top Ten EG exporters and importers in 2006, USD billion

Country	Exports	Country	Imports
USA	108.0	USA	107.0
Germany	108.0	Germany	89.0
China	65.0	China	77.0
Canada	25.0	Mexico	26.0
Mexico	24.0	Canada	25.0
Korea, Rep. of	20.0	Korea, Rep. of	23.0
Hong Kong	15.6	Hong Kong	16.0
Belgium	13.2	Denmark	7.7
Austria	12.4	Malaysia	6.6
Sweden	10.5	Russian Fed.	6.2

Source: Jha, 2008.

According to Sawnhey, the main factors demanding environmental services have been population size and its purchasing power, the stringency of environmental regulations and the degraded state of environment. The growing population in Asia and the low state of access to infrastructure environmental services has been accompanied by the low purchasing power of the population. Meanwhile, environmental policies have become increasingly stringent from the ‘90s. Industrial growth and urbanisation has generated severe environmental problems in Asian countries including land degradation, deforestation, loss of freshwater and air pollution. For example, 58% of groundwater is contaminated with coli-form in the Philippines, and over 40% of Chinese Taipei’s rivers are polluted with wastewater. At the same time, the supply side of the environment market has been driven by strong government commitment and investment in the provision of basic environmental services (water purification, wastewater treatment, household solid waste management), the different capacity of the domestic environmental service firms in different countries as well as open economic policies to bridge the gap in domestic supply.

The '90s saw a considerable rate of privatisation of and foreign investment in traditional public services in Asian countries. Privatisation was most significant in Malaysia, Indonesia, Thailand and the Philippines. Countries with a well-established environmental industry are in a better position to supply their domestic markets, although even the most advanced Asian countries (in terms of environmental industry) need technology imports from Japan, the U.S. and the EU. The main investors in Asian environmental services were large multinational companies from industrialized countries that have, in the past few years, reduced investments in Asia and moved towards transition countries in Central and Eastern Europe and some selected Asian countries like China (*Sawnhey,* 2006).

The EGS market in China was $5 billion in 2000 with estimates to grow to 15 billion by 2010. Demand was expected to grow within petrochemical, steel, energy and automotive industries. Despite early regulations from the '90s, the still weak regulatory framework hinders the development of EGS market in India. The main driving forces are renewable energy and municipal management. Environmental services were estimated to reach $7 billion by 2010. In Latin-America the single largest market is Mexico with about $3-4 billion. The major environmental needs in this country generate demand in air and water pollution control. Brazil, Venezuela, Chile, Argentina and Colombia together represent a $4 billion market, mainly in air pollution control.

The market for the CEE countries was over $18 billion in 2005. Environmental demand is mainly generated by the relative neglect of environmental issues during the socialist era. Critical demand sectors are water pollution control and recycling. The Middle East and North Africa are estimated to make up a market of $5 billion with an annual growth rate of 3.8 per cent. The main problem within the development of environment sector is the general lack of environmental awareness. The size of the market for the Asia–Pacific area was estimated at $ 32 billion in 2004. Countries within the Association of Southeast Asian Nations (especially Thailand, Indonesia, Malaysia and the Philippines) were major actors of EGS consumption. Main sectors of the market are solid waste management, water purification and wastewater treatment. The Sub-Saharan market for EGS was estimated at $2.2 billion in 1996 with a 10% growth rate. The most typical sectors here included water and wastewater (*Jha,* 2008).

Some experts stress the importance of environmental industry in enhancing the goals of sustainable development (*Wysokinska,* 2005; *Yu,* 2007; *Kennett and Steenblik,* 2005). Others argue that the liberalization of environment markets in developing countries was in fact beneficial for developed countries that sought for new markets for their products on the one hand. On the other hand, liberalization could easily impose barriers of entry in many markets for developing countries through stringent environmental regulation. It is also stated that even though issues of industrial pollution were driven onto the political and regulatory agenda by strengthening environmental consciousness, they are economic factors that do and will shape the development of environment industry and cleaner technologies (*Barton*, 1997). *Table 6* suggests a temporal framing for the developmental phases of global environmental industry.

Table 6

Phases of development of the global environmental industry

Phase of development	typical period
Regulation of 'dirty' industries in developed countries	beginning from the 1970's
Emergence of strong environmental industries and cleaner technology initiatives with fast market growth in developed countries	1980's – 1990's
North-South Technology transfer and globalisation of markets, liberalization of communal and environmental services in Asian and Latin-American developing countries	1990's – 2000's
Liberalization of communal and environmental services in developing countries of Central and eastern Europe and some Asian countries (China)	2000's

Source: Authors' construction based on sources referred

The future of Eco-Industries: circular economy?

When describing eco-industries it is important to mention that various attempts have been made in industrialized countries to tackle environmental damage. These include the relocation of 'dirty' industries to developing countries, structural change of industries and ecological modernisation of heavily polluting industries. However, the ecological results of these attempts (including end-of-pipe techniques of the environmental industry) have so far proved to be disappointing (*Jänicke et al.*, 1997; *Adamides and Mouzakitis,* 2009).

While the environmental industry of the '80s mostly comprised of activities related to end-of-pipe pollution treatment, the '90s marked a shift towards cleaner technologies (at least in the literature) (*Duchin et al.*, 1995; *Jaffe et al.*, 1995; *Barton,* 1997; *Jänicke,* 1997; *Luken and Freij,* 1995). The first decade of the 21st century has brought about novel concepts, like *industrial ecology, circular economy (CE) and industrial ecosystems*, that can be regarded as a "desired new state of the industrial production socio-technical system" originating from an evolutionary institutionalism perspective (*Adamides and Mouzakitis,* 2009 p. 172.) rather than a consequential stage following the developmental path of environmental industry. These initiatives will be referred to by the umbrella term industrial ecology in the followings.

There is a vast literature on industrial ecology, which has caught attention since the late '90s. The new ecological-economic thinking has gradually oozed into political debates in other countries, like China (*Fang et al.,* 2007). However, the frames of this paper only allow for a short presentation of these concepts. Industrial ecology "uses an ecosystem metaphor and natural analogy to study and improve the resource productivity and reduce the environmental burden of industrial and consumer products and their production and consumption systems" (*van Berkel et al.,* 2009). It is based on the starting point that since nature is the most efficient in all its processes, with no waste produced and closed material cycles, industrial as well as production-consumption processes should attempt to 'imitate' these processes (Biomimicry) (*Benyus*, 1997; *Kiss*, 2005).

Innovations of industrial ecology and all the related initiatives are largely stimulated by cost cutting efforts and a search for competitive advantages at firms. At the same time, the pressure to fulfil regulatory requirements has often brought the same result of being technologically advanced and competitive on the long term (*Triebswetter and Wackerbauer,* 2008).

According to Adamides and Mouzakitis (2009) transition into an *industrial ecology-inspired industrial production system* needs elementary changes in the current socio-technological system. These changes, however, are mostly resisted by the prevailing industrial production regime. They state that *strategic niche management approach* (SNM) is an appropriate means to bring about the necessary changes by ensuring spaces protected from market forces (i.e. niches) to develop, produce and use new technologies.

Implications for Hungary

According to the global trend of environmental investments continuously moving from some selected target areas to others, Central and Eastern Europe (CEE) is predicted to be the next target area of such investments. Some evidence of private multinational involvement has already been witnessed in the communal services sector in Hungary.

As for the environmental efficiency of Hungarian industry, it can be stated that environmental expenditures are dominated by less efficient and somewhat outmoded end-of-pipe pollution control techniques. Eighty-two per cent of environmental investments were spent on the clean-up of already existing pollution and 18% on integrated pollution abatement solutions (KSH, 2006). In this sense the state of the Hungarian environmental industry corresponds to that of the US, Germany and Japan in the 90's.

Fifty-one per cent of all environmental investments were brought about by the public sector. The vast majority (49%) of environmental investments were spent on wastewater treatment, on air quality control and groundwater protection 14-14% each, while 11% were used for waste management and 5% to landscape and natural protection.

In 2005 there was a 13% fallback in the environmental investments of firms in the industry sector, continuing the decrease of the past few years. This is due to the 19% drop of investments in end-of-pipe equipments which could not be compensated with the 12% rise of investments in integrated environmental techniques, in spite of the fact that the latter kind of investments made up 26 per cent of total investments of the whole industry sector. The growth of Hungarian environmental expenditures is largely dominated by the growth of intra-firm spending which was reckoned to be 21% from 2004 to 2005 while payments to external environmental providers reduced by 9% (KSH, 2006).[1]

Given the economic dominance, technological advance and political force of countries and firms that dominate the environmental market, small transition economies like Hungary have little chance to become a determinant actor. Nevertheless, the development of environmental industry and especially integrated environmental technologies has important implications. First, there should be stronger emphasis on efficiency gains attainable by integrated environmental solutions, thus *end-of-pipe techniques should soon be replaced by at least clean technologies*, preferably by solutions of industrial ecology. Second, the technology gap that Hungary suffers in the environmental industry sector needs relatively *high levels of R&D* to be worked out. Third, the economic viability of domestic firms on the highly innovative environmental market, as well as a feasibly painless transition to environmentally sound production systems needs strong *strategic niche management*.

Summary and conclusions

The current state of environmental industry can be considered as a phase in the evolution of attempts to eliminate environmentally harmful effects generated by industrial activities. Its development was largely based on strict environmental regulations originating in the industrialized, developed countries. Countries that responded early to regulatory conditions assured such competitive gains that predominantly shape the market even today. Environmental industry has been a major subject of international trade negotiations. It is often stated that environmental industry has been a means of technology transfer and export market opportunity for developed countries. On the whole, end-of-pipe techniques provided market opportunity by growing exports, while integrated pollution abatement and resource-efficient systems could result in cost savings for firms. There is growth potential for the market in developing countries, albeit the overall growth of the global market has slowed down. Investments in environmental production and services are currently moving from selected Asian areas to Central and Eastern Europe. Novel solutions of environmental efficiency integrated in production-consumption systems mark the next phase of industrial activities following the requirements of sustainable development.

The transformation from a single economic sector (environmental industry) into naturally sound, resource-saving and pollution-minimized practices inherent in every socio-economic activity underlines the future of economic progress and environmental sustainability.

Notes

[1] A detailed analysis of the Hungarian environmental industry is to be found in the following chapters.

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THE ROLE OF INNOVATION FACTORS INFLUENCING THE CONDITIONS OF ENVIRONMENTAL INDUSTRY IN HUNGARY

Lajos Oláh

Introduction

The continuous development of skills and knowledge is a strong pillar for the strengthening of both the professional and the social positions of environmental issues. A target area of the coordinating and management activity of the Ministry of Environment and Water (hereinafter: MEW) is environmental education, public and higher education, vocational training and adult training, and a dominant field of the support programmes of the Ministry is research, and the continuous development of informatics (information systems) and innovation. The essay focuses on a topic in this latter area, the importance of innovation, and it looks at the role of the innovation factors in influencing the conditions of environmental industry. It starts from the well-known fact that in the modern, knowledge-based economy a condition for the keeping of competitiveness is environment friendly innovative behaviour, together with the high level of knowledge and a developed technological basis.

In the statue of the MEW, selected tasks are the definition of the research and technical development directives of the activities coordinated by the Ministry, the statement of the main directions of development, and the cooperation of the implementation of the R & D tasks of the state, in line with the general system of the management of R & D. The Ministry set among its strategic objectives the targeted networking of research and environmental knowledge management, and the development of its elements. In the approach to the environmental researches the general principle is applied that complex environmental problems affect several sectors, accordingly their management also necessarily requires a cooperative (*horizontal*) approach. On the other hand, the objectives of environment protection have to be met in the total of the economic activities (*vertical approach*) in a way that it should also serve the purposes of environmental policy. In this approach the essay focuses on the features of environmental industry more and more relying on research findings, analysing in details the management system of R & D & I and the medium-term strategic objectives of the ministry of the environment.

Characteristics and innovation performance of environment protection

The character of environmental industry

Environmental industry means activities producing technologies, products and services used for the measurement, prevention, moderation, decrease or regeneration of environmental burdens affecting water, air and soil, including the problems related to waste, noise and different ecosystems. Environmental industry – relying on *research* findings – is the industry having the most dynamically growing market internationally, offering huge possibilities also for the increase of the competitiveness of Hungarian companies engaged with environmental industry activities.

Environmental investments, expenditure and revenues in Hungary

Knowing the growing significance of environment protection, nobody questions the importance of investments in the environment. The environmental investments of the Hungarian economy reached HUF 171 billion in 2007 (approximately € 680.4 million calculated with the mean exchange rate of the National Bank of Hungary, NBH), from which 88% was *direct* and 12% *integrated environmental investment* (integrated into a larger process). The volume of *direct* environmental investments grew by 5%, while that of integrated investments fell to one-third from 2001 to 2007 (*Figure 1*).

In the period in question, the major part, approximately 47% of the environmental investments was targeted at *sewage treatment*. Twenty-three per cent of all investments served *air cleanliness*; 12% was used for *waste management*, while investments for the protection of surface and subsurface waters had an 8% and investments for landscape and nature protection a 6% share. Within *environmental investments integrated into wider processes*, the proportion of sewage treatment was 41%, that of the protection of air cleanliness 39%.

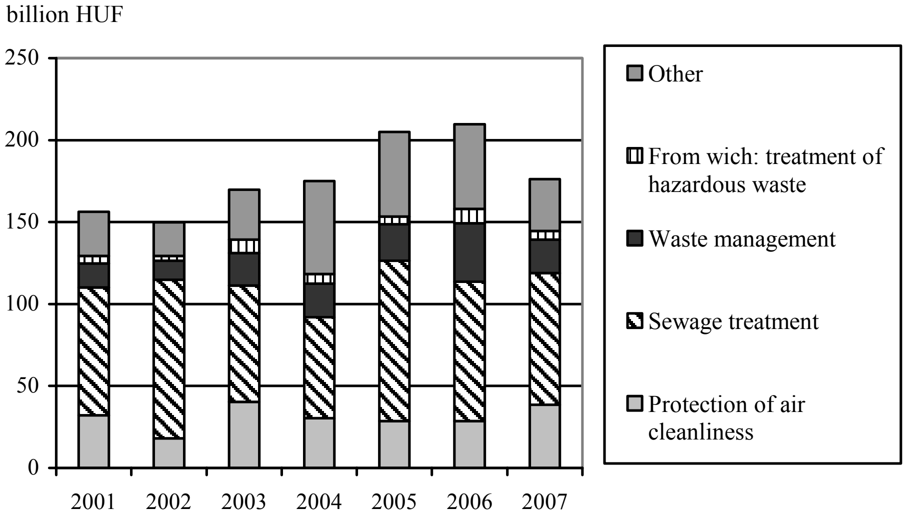
From the sectors of the economy, the share of *public administration* was the most significant, the investments of this sector made 29% of all environmental investments in 2007. The economic organisations in sectors other than public administration realised almost 94% of their environmental investments from their own financial resources in 2007; at the same time, some 5% of their investments were financed by direct EU support or Hungarian government subsidy.

In the Hungarian economy, the value of environmental expenditure within the organisations reaches HUF 205 billion (i.e. € 817.5 million using the NBH rates).

The breakdown of these expenses is as follows: 41% for sewage treatment, 28% in waste management, while air both air cleanliness and the protection of surface and subsurface waters had 3% each. Seventy-six per cent of the environmental investments realised within organisations were done at economic units specialised for environmental services, engaged primarily with sewage and waste treatment, and public sanitation services.

Figure 1

Environmental investments, by environmental sectors, at current prices, 2001–2007



Note: Calculated with the man annual exchange rates of the NBH in the given year.
Source: Hungarian Central Statistical Office (HCSO).

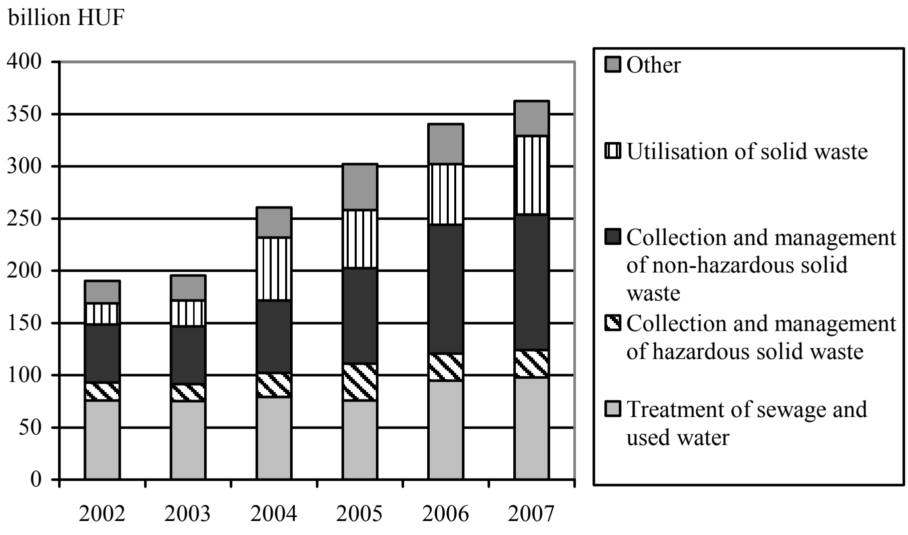
Revenues of environmental industry, output of the sub-sectors

On the basis of the data provided by the organisations involved in the survey, the net value of the products and services sold by economic organisations in the sector of environmental industry reached HUF 307 billion, i.e. € 1.47 billion using the exchange rates of the NBH. It was 23 billion Forints more in 2007 than in 2006 – which is € 91 million by the 2006 rates (*Figure 2*).

From the total of the *revenues* of environmental industry, 98.2% was made by revenues from the manufacturing of products used for the direct decrease of environment pollutions, and from the provision of such services. The manufacturing of technologies and products serving the integrated decrease of environment pollution reached the value of almost 7 billion Forints, i.e. € 27.8 million by NBH exchange rates (1.8%). Looking at the dominant sub-sectors of environmental industry, the activity called regaining of raw materials from waste (recycling) reached over HUF 19 billion (€ 75.6 million) net revenue in 2007. Wholesale trade of waste had HUF 68 billion (€ 270.5 million) revenues in 2007, almost 64% of which was from the collection, management and neutralisation of non-hazardous solid waste.

Figure 2.

Product manufacturing and service provision with direct environment pollution decrease objectives, at current prices, 2002–2007



Source: HCSO.

The contribution of organisations engaged with *water production, treatment and distribution* to environmental industry mainly comes from their sewage treatment activity: they had revenues of approximately HUF 56 billion in 2007 (i.e. € 222.8 million calculated with annual mean exchange rates of 2007 of the NBH). The revenues of organisations listed in the sector called sewage and waste treatment, and prevention of pollutions was a little over HUF 177 billion in 2007 (i.e. € 616.8 million), approximately 49% of this came from the collection, management and neutralisation of non-hazardous solid waste.

Innovative environment protection as a pull sector in export

Export sales of environmental industry exceeded HUF 73 billion in 2007 – i.e. € 290 million with the exchange rates of 2007 of the NBH –, which is almost 20% of all sales of environmental industry. It is a pleasure that export sales grew by more than 50% in 2006 after an unexpected fall in 2005, and this high level continued to exist in 2007, too (*Figure 3*).

In the "marketing" of the research and innovation findings and in the increase of the competitiveness of the Hungarian environmental industry, an important role is played by the promotion of the export activity and the investments of the Hungarian companies having innovative products, in the framework of the programme called export of the environmental industry (KEXPORT by the Hungarian acronym). The Hungarian practice of the use of the knowledge, advanced technologies and innovative solutions accumulated in the *Hungarian environmental industry* does not only offer the possibility of a more intensive participation on the foreign markets but also the preference of Hungarian environmental industry suppliers at the large-scale investments and infrastructure developments implemented in Hungary. This way environment protection may become a pull sector.

Figure 3.

Export and domestic sales of environmental industry, in million €, 2004–2007

Note: Calculated with the man annual exchange rates of the NBH in the given year.
Source: HCSO, NBH.

The Hungarian water and environmental industry companies can implement projects in the framework of European and Asian national programmes, among other things in the fields of *biological sewage treatment*, *waste management*, *protection of water bases*, *damage elimination*, *drinking water purification* and the *use of thermal waters*. As a member of the European Union, Hungary assists the domestic use of environmental technologies and the related developments and investments in several ways. The promotion of the information on the available environmental technologies and development in Hungary, the dissemination of information on the tendering and other support systems is of vital importance for the improvement of the market positions.

As a part of *knowledge management* the need arises for the environmental and nature protection cooperations of the Hungarian settlements and their Hungarian-inhabited counterparts cross the borders, which need comes from the joint global, regional and local challenges and the ecological features of the Carpathian Basin. A precondition to meet the challenges is the strengthening of environment consciousness, the training of skilled experts, the flow of information and the coordination of activities in the whole region, in which the Hungarians can play a lead role. The objective of the so-called Hungarians with Hungarians Green Programme launched in 2007, among other things, is to contribute to the relations of the Hungarians in Hungary to their fellow Hungarians across the borders, by the utilisation of the Hungarian intellectual capital also in the field of environmental and nature protection.

Businesses and professional associations assisting environmental industry

The *Association of Environmental Service Providers and Manufacturers* (hereinafter: AESPM) is a professional body; the award of the public use organisation status to the Association in underway. The sector of environmental industry, that has seen a very rapid growth since the 1990s, involves service providers, recyclers, the manufacturers and distributors of emission-decreasing equipments used for the protection of the environment, the operators of measurement laboratories, the researchers and marketers of cleaner technologies. The composition of the membership reflects this versatility; the Association is homogeneous from only one aspect: all members are active in the protection of the environment. The AESPM with more than 300 members is one of the largest professional organisations in Hungary.

The AESPM does and serves the improvement of the environmental state of Hungary, the development of the environmental culture, the shaping of environmental consciousness with its own tools. It coordinates and organises, among other things, the organisations active in the field of environment protection, it harmonises and represents their interests from a professional view, and initiates the development of the international economic relations. It promotes the dissemination of environmental skills with publications, the organisation of conferences and trainings. It assists the cooperation of its members with local governments, entrepreneurs and the organisations related to their activities. On its own and through it members it builds out and maintains information, reconciliation, and decision preparatory relations with all those national, municipal, social and economic organisations and in all those fields where the assertion of the professional interests of the members makes it reasonable and necessary.

The *Hungarian Water Utility Association* (in its Hungarian acronym: MaVíz) is an independent professional interest representation organisation established by the Hungarian drinking water and canalisation service providers and the related water industry and trade. It coordinates the economic organisations working in the water industry; it does a technical, economic and legal harmonisation and interest representation activity for its members; it promotes the establishment and development of international economic and professional relations; it supports the penetration of advanced technologies and economic analysis methods. The Association is a member in the *National of Employers and Factory Owners Association*, the *European Federation of National Associations of Water and Waste Water Services* (EUREAU), and in the *International Water Supply Association* (IWSA). It has connections with several other Hungarian and foreign professional and academic organisations and it is a constant partner of the state and municipal administrative organs. The approximately 100 member organisations of the Association are responsible for the provision of 95% of the water utility services of Hungary, another over 100 members or member organisations represent the water industry and trade and its business background in Hungary.

Employment in environmental industry

The *economic organisations employed* a total of 19,489 persons in connection with environmental industry activities in 2007. Of these, 19,137 employees (i.e. 98% of all those employed in environmental industry-related activities) were active in the manufacturing of goods and provision of services for the direct decrease of pollution, and no more than 352 people (2%) were employed in the manufacturing of integrated pollution decreasing technologies and products. The *service providers* in environmental industry employed 16,750 people in connection with environment protection in 2007, while other organisations included in our data collection gave work to another 4,335 people. A targeted survey was conducted in 2008 on the issue of employment in the sector, called "The situation of vocational training in water management"; this survey primarily focused on the collection and analysis of data concerning the professional skills and age structure of the staff of the environment and water management directorates. In general we can draw the conclusion that the skills and the age composition of the staff of the employers in question are far from being favourable, which indicates the importance of the training of water management experts who will be responsible for the environmental tasks, and also suggests that it is necessary to extend the examination to all employees under the professional coordination of the Ministry.

Research and development, innovation

A general situation

The summary of the *New Hungary Development Plan* (NHDP) says that the role and tasks of science have considerably changed by the beginning of the 21st century. Society expects science to continuously contribute to the solution of societal problems, the successful adaptation of the country and the nation in all fields, *intellectual* development *in harmony with the environment*, and the progress of technology and thereby of the economy. This also coincides with the intention of the Government, inasmuch as both economic and social innovation can only be successful if they are founded by the recognition and support of academic research bearing high level intellectual value.

According to the strategy of the Government, knowledge-driven economy raises many tasks to be solved, whose research cannot be fitted into the traditional disciplines of science. The solution of such tasks requires new *inter-, multi- and transdisciplinary* research methods, research organisational concepts and a new management of researches. The new global challenges affecting the future of mankind give *complex* tasks, the majority of which can only be solved in international cooperation. Such “global issues” are health preservation, *environment protection*, energy sources and information society. This reasoning again reflects to the *complex*, multidisciplinary character of environment protection in which the boundary between basic and applied researches is blurred and inter- and multidisciplinary researches are in the foreground.

The analyses of the situation in Hungary all clearly demonstrate that the amount R & D financing is *imbalanced* in Hungary. The R & D expenditure of the public sector in per cent of the GDP in Hungary is close to the EU average (0.54%, and 0.69%, respectively), but the expenditure of the business sector is significantly below the EU level in Hungary (0.37%, as opposed to the EU average of 1.07%). Since the late 1990s a significant development and reorganisation process has been going on in some fields of the science life in Hungary too. The result of this was the expansion of higher education, the establishment of doctoral schools, the integration programme of the universities and the consolidation of the institutes of the Hungarian Academy of Sciences. Research activities are *fragmented*; research groups with a critical number of academics for the effective work have not been created. In the field of foreign patents, especially in the European and American high-tech patents, Hungary lags behind the EU average.

According to the comparative data of the EU, the *summary innovation index* (SII) of Hungary was 0.31 in 2005, which was only 72% of the average of the EU member states. *With this figure Hungary had position 15 in the order of the 25 member states.* (This complex index summarises a total of 26 indicators in five groups.) According to the data of the Hungarian Central Statistical Office (HCSO), in 2005 there were 749 companies in Hungary engaged with R & D activity. The concentration of the sector is great: 17 large companies are responsible for approximately half of the total R & D budget of the business sector, but this amount is not more than 1.3% of all revenues of these 17 companies, so even these cannot be taken as companies of large research intensity in an international comparison. As regards the Hungarian business R & D budget, 75–80% of this comes from the foreign owned companies, of whom 38 operated research and development units in Hungary in 2006.

Despite the achievements of international level, the performance of the Hungarian R & D sector still lags far behind the average of the European Union. While the 15 "old" member states of the Union spent 1.92% of their GDP on research and development in 2004 (which is quite low compared to the United States and Japan, anyway), this figure was only 0.89% in Hungary. In addition, less than one-third of the R & D expenditure is financed by the business sector in Hungary, which is way below the 55% proportion in the European Union.

The present Hungarian *taxation system* has developed a lot in the recent years, as regards the promotion of R & D. According to the comparative analyses of the OECD, Hungary was among the first countries as regards the *tax allowances* applied for the promotion of R & D. There are significant tensions, however, in the field of contributions to be paid for employees. The number of *publications* per one million inhabitants is approximately half of the average of the EU 15, but the number of publications per one researcher is close to the EU average.

Unfortunately, the *flow of knowledge* between the *academic and the business sector* is unsatisfactory. Economic aspects are not taken into consideration in the management work of the public financed research places, or in the selection of the research topics and the evaluation of the researchers. Dynamic development is occasionally blocked by rigid, discipline-based structures; the majority of the research places is in a need of reform. There are hardly any exchanges between the budgetary research places and the businesses, but the *mobility of the researchers* among the different research institutes and topics is inadequate to. The number of workplace changes per one researcher was only 0.11 on the average in 2000–2004. The promotion and support of the return of young researchers working abroad is unsolved, too. The innovation activity of the Hungarian small and medium-sized enterprises is below the level typical in the more advanced economies. There are too few spin-off companies "dispersing" from the knowledge centres.

The north-western part of Hungary has successfully attracted foreign direct investments, and by the imported technologies it is in a good innovation position, however, still there are few innovations built on own researches, due the weakness of the R & D capacities. The major university centres of the capital city and the eastern part of Hungary – this latter with lower innovation capacity – have significant research centres, but these institution have not yet been able to become the real innovation centres of their regions, except in the capital city. The regional breakdown of R & D resources shows a two-thirds concentration of the indicators in the region of Central Hungary.

With the objective to strengthen the R & D & I capacity of the regions, *central innovation initiatives* of integrating character, built on wide cooperation and promoting networking, have appeared recently. Such initiatives are the regional university knowledge centres, the cooperation research centres, the pull sector programmes, the large international programmes and the regional innovation agencies. The Hungarian support system places a great emphasis on the integrated and harmonised management of the R & D and innovation resources. An important goal is the support of cooperative research activities and the concentration of the researches, the utilisation of the R & D results in the economic and business life, and the creation of the institutional system of regional innovation. As regards the resources and capacities influencing research and development and innovation activity, the sectors are very different. More than one-third of the net revenues is earned by manufacturing industry. The share of all other sectors remains below 8%. More than 70% (exactly 73%) of the R & D budget of businesses is paid by manufacturing industry companies. In the field of R & D expenditure, sectors like construction industry, food industry, electricity supply, and postal and telecommunications services are far less important than their weight in the economy would suggest. On the other hand, there are sectors with considerable R & D expenditure (capacity), sectors that are dynamically developing and have outstanding development possibilities in an international comparison: these are pharmaceutical industry, *environmental industry*, biotechnology and information technology. Sectors with development potential for the small and medium-sized enterprises and for human resources are car industry (vehicle electronics and sensor technologies) and food industry. The development of the manufacture of road vehicles and telecommunications equipment is also promising.

Innovation was given an even greater emphasis than before in the New Hungary Development Plan made for the 2007–2013 period. In this programming period EU resources worth almost 230 billion Forints, € 915 million with NBH exchange rates of 2008, can be spent on innovation by the Hungarian tenderers.

From this amount, among other things, *market-oriented research and development* can be financed, including industrial researches up to the development of the prototypes and basic experimental researches. The tenderable amount of support is HUF 2 billion (almost € 8 million) in the Central Hungarian region, while the other six regions are eligible for a total of HUF 7 billion (€ 27.8 million); this support is only available for micro-, small and medium-sized enterprises, the grants awarded may range from 50 to 300 million Forints (from € 0.2 to 12 million). In order to strengthen the cooperation between the universities and research places, and the business sector, a requirement of this tender is that the supported applicants must spend at least one-quarter of the support grant on research services ordered from the universities and research places.

As the next step of the innovation process – the marketing of innovation –, under the heading *Support of the innovation of companies*, there is a tenderable framework support of HUF 3.6 billion (€ 14.3 million with the exchange rates of the NBH of 2008), the other six regions are eligible for HUF 14 billion (i.e. € 55.72 million); only micro-, small and medium-sized enterprises are eligible for this support, as in the case of the previously mentioned subsidy. The awarded support can be 25 to 200 million Forints (i.e. € 100,000 to 796,000), the awarded businesses can spend this support, among other things, on product, service or technology development, testing, test operations and marketing activity necessary for entering the market.

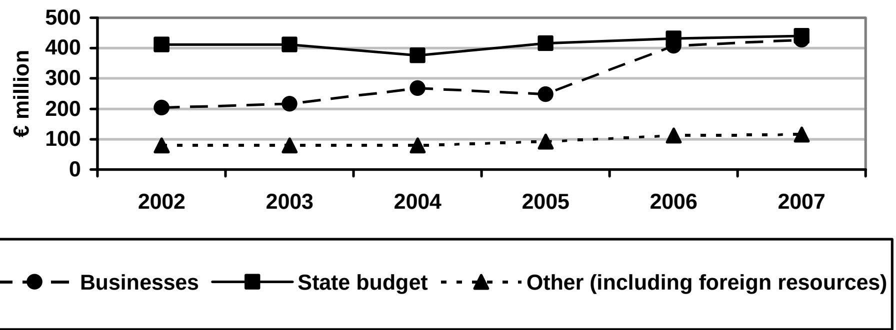
Of course the efficiency of research and development requires the presence of well functioning *research centres* and well-equipped innovation and technology parks. As a continuation of the tender of the 1st National Development Plan of Hungary aiming at the establishment of cooperation research centres, a total of HUF 2 billion (almost € 8 million, calculated with the NBH exchange rates of 2008) of EU resources can be spent on the *development of research and development centres* in the region of Central Hungary and another HUF 6 billion (€ 23.8 million) in the other six regions. The basic objective of this tender is to strengthen those so-called cooperation research centres, created for the cooperation of the universities and research places with the business sector, and the regional university knowledge centres, which have already achieved results and operate as economic companies. By the cooperation of these the knowledge generated in higher education can have a fertilising effect on the innovation process and thereby on the competitiveness of the economy. The support available for these companies can be from HUF 400 million to 1 billion (i.e. € 1.6–4.0 million).

As regards the issue of *financing*, the present support system of Hungary is below the average of the European Union in all respects. In the so-called innovation readiness Hungary is in the bottom third of the community order. R & D absorbs just one per cent of the gross domestic product (GDP), by which

Hungary lags far behind the EU average of 1.8%. In addition, there are huge spatial disparities in Hungary in this respect: 70% of this money is spent in Central Hungary. It is a promising change, however, that the share of the state from R & D expenditure shifted from the former 70%, now it is only 45 per cent and businesses are now responsible for 43% of the R & D budget; however, this is still far from the 70% typical in European Union (*Figure 4*).

Figure 4.

Breakdown of national R & D financing

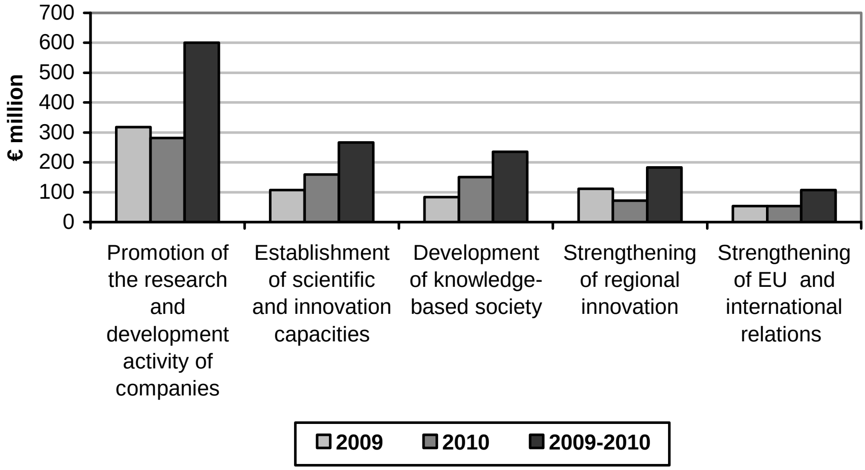


Note: Calculated with an exchange rate of 250 HUF/Euro.
Source: National Office for Research and Technology (NKTH) – HCSO.

On the basis of the analysis of *expected trends*, in 2009 and 2010 Hungary will spend HUF 250-290 billion annually, i.e. € 995–1,154 million calculated with the 2008 exchange rates of the NBH, on research and development purposes. For the realisation and assistance of these goals, there will be HUF 170 billion (€ 676.6 million) tender resources available for research and development and innovation purposes in 2009, in 2010 it will be almost HUF 180 billion (€ 716,4 million). In order to make sure that each stakeholder has adequate information on the tendering possibilities – including the volume and goal of the resources they are eligible for –, in early 2009 a *research and development and innovation resource map* for the years 2009 and 2010 was made. This map made a comprehensive and full representation of the Hungarian and the Union budgetary resources, also indicating the availability of further detailed information. The resource map contains all major Hungarian, European Union and bilateral support possibilities that support research and development and innovation in accordance with the priorities and objectives stated in them. The resources are featured below in a grouping equivalent with the priorities of the medium-term science, technology and innovation policy strategy of the Hungarian Government (2007–2013) (*Figure 5*).

Figure 5.

Breakdown of the resources by strategic priorities, in million €



Note: Calculated with a mean exchange rate of 2008 of the NBH.
Source: Medium-term science, technology and innovation policy strategy of the Hungarian Government (2007–2013).

The realisation of the strategic and competitiveness objectives common with the European Union requires a comprehensive, strategic approach. The European Union has realised that the outstanding performance in basic researches is not adequately matched by the utilisation of the research findings in the economy. In 2000 then an ambitious objective was stated at the *Lisbon summit*: by 2010 the EU should be the most competitive, most dynamic knowledge-driven economy in the world. A further objective set at the *Barcelona meeting* of the Council of Europe in 2002 was as follows: on the average of the EU the R & D expenditure should reach 3% of the GDP, and two-thirds of this expenditure should come from the business sector. In October 2006, according to the statement of the *Lahti summit*, by 2010 the R & D expenditure of Europe will reach 2.6% of the GDP. It is a vested interest of Hungary, considering its own situation, financial possibilities and efforts, to contribute to the implementation of the common European objectives, in addition to define its own national interests and strategic goals.

A regards the *tasks of the state*, the strategic role of the state considerably increases in the field of science, technology and innovation. The objective of the active, initiating state performance is the harmonised and effective operation of the national innovation system. State participation is reasonable also in the development of large-budget research infrastructure, to allow the birth of research and development bases competitive at international level. Looking at the necessity of state participation we also see that state supports are also justified by one more fact: the higher the complexity of the problems to be solved, the less able the respective Hungarian institutions to secure the financial resources of a given project on their own. Another reason is the necessity of researches of *public interest* (connected to e.g. flood forecasting, public security, national defence, authority procedures, the sustainability of development, consumer protection or social policy, population policy, health care, the social effect of new technologies and the ethic of the application of these technologies).

The role of ministries involved in environmental researches

Ministry of Environment and Water (MEW)

For the coordination at national level, in accordance with the former practice, the Ministry is still responsible for the *as effective as possible cooperation* with the Hungarian research management organisations, the interested ministries and sectoral organisations *in the field of environmental researches and innovation*, in order to establish the R & D & I strategies and tender systems. Because of the intersectoral character of environment protection, this activity actually concerns the whole Hungarian R & D & I sector (state administration, universities, academic research places, non-governmental organisations etc.). An important task is the increase of the proportion of resources available for the *small and medium-sized enterprises* operating in the field of technical development and innovation. At the same time, in the areas of *public use*, of *global importance* – where the economic actors are not or only less interested – public resources should be used for the launch of inter-ministry programmes for the maintenance and regeneration of the state of the environment.

For the implementation of the research plans of the ministry providing a scientific foundation of its *direct tasks* (strategies, concepts, assessments, measurement and observation, and information systems, legal, economic and technical regulation, international agreements, attitude shaping), it is still mainly state resources that should be provided. Following the successful example of the European Union, it is reasonable to organise (primarily virtual) *Research Excellence Centres* with the inclusion of public resources also in the special fields of environment protection. The most urgent tasks in this respects are as follows:

- National level coordination of the Hungarian environment and nature protection, water management and meteorological researches;
- For the establishment of R & D & I strategies and tender systems, as effective as possible cooperation in the field of environment protection,

nature protection and water management research and development and innovation with the Hungarian research management organisations (National Office for Research and Technology, Hungarian Academy of Sciences, National Scientific Research Fund Office), the interested ministries and sectoral organisations;

- Professional assistance for the increase of the proportion of resources (at tenders announced by the National Office for Research and Technology) for the support of research institutes, universities, research places, small and medium-sized enterprises active in the field of environmental policy, technical development and innovation, and their consortia (National Technology Programme, National Technology Platform);
- Contribution to the working out of tasks, strategic directives, programmes and individual projects set in the cooperation agreements between the Prime Minister's Office and the HAS, and the MEW and HAS;
- Together with the HAS, organisation of the annual central programmes of the event called Celebration of the Hungarian Science and the programmes within the sector of environmental industry;
- Contribution to decision-making on the annual Innovation Awards (Environment Protection Innovation Award and Gábor Dénes Award), in cooperation with the Hungarian Innovation Association and the NOVOFER Foundation;
- As a part of the strong state participation, coordination of the Hungarian sector-specific research society in International Technical Science Cooperations, with special regard to the participation of Hungary in the EU Research, Technology-development and Demonstration Framework Programme (representation of the ministry in the CIRCLE ERA-Net, and the BiodivErsA ERA-Net programmes).

Ministry of Health

It is well-known that hazardous materials present in the environment, due to natural processes and pollutions caused by human activities, can be sources of illnesses. The knowledge concerning the impact of the environmental factors on human health must be deepened, and it should be more and more considered in the formation of the policy of the European Union. We cannot forget, either, that really effective action and the solution of the problems is only possible by the cooperation of the member states. Driven by this objective, the *Commission published* on 9 June 2004 *its action plan for the decrease of the frequency of diseases caused by the environmental pollutions, valid for the 2004–2010 period* ("Environment and Health Action Plan 2004–2010"). It is part of the European Union strategy on environment and health, approved in June 2003, called SCALE initiative (SCALE – Science, Children, Awareness raising, Legal instruments and Evaluation), which is a children-focused initiative based on scientific foundations, and it includes the raising of the consciousness of correlation between *environment* and health, the use of legal tools and continuous evaluation. The primary objective of the strategy is to decrease the health impacts of *environmental pollution* and the diseases caused by this, with special regard to children. Implementation, realisation of the objectives is the joint responsibility of the commissioners of environment protection, research and health.

The action plan is meant to improve coordination among the administrations of *environment protection*, research and health care. The *priorities of the 2009–2001 period* include the examinations of the health damaging impacts of the natural and social environment. This broad range of issues includes direct and indirect environmental topics, among other things researches on the prevention, and the genetic and environmental determinations of widespread diseases; health damaging impacts of the natural and social environment; and surveys on the defence mechanisms of the cells against environmental damages.

Ministry of Agriculture and Rural Development

The MARD possesses the foundations of the modern Hungarian innovation system, but the elements of the system should be re-tuned in order to reach a higher efficiency, starting from the revision of the science, technology and innovation strategy of the Hungarian government through the coordination of the resources in inter-ministry consensus to the definition of the objectives of the tenders. For the reinforcement of the capacities of the agricultural sector, in the framework of the National Technology Programme of the Research and Technology Innovation Fund, the sub-programme called "*Competitive agriculture and food industry*" supports R & D & I objectives. The participation of agriculture was successful in 2008 in the call for tenders announced as a continuation of the so-called *Jedlik Ányos Programme*. The significance of the sub-programme was also in promoting the joint work, cooperation of the agricultural businesses and the higher education and research institutions. In addition to the elements listed above, the reconsideration of the national research and development strategy is necessary, in which the main direction of the "National Agricultural Research and Development and Innovation Strategy" should be an integral part.

As agriculture (especially intensive farming), coming from its very nature, is a serious hazard for our natural environment (soil pollution, water pollution, air pollution), several researches are going on in this field and even more researches should be necessary. Looking at the most important research topics – connected to agro-environment protection –, the following topics should be mentioned:

1. *Gene technology* – biotechnology. A selected topic is the provision of the molecular biology background of up-to-date environmental technologies. Within the energy plant programme, the initial steps in the improvement of black locust for energy production have been made. As a continuation of this, in the near future researches will focus on environment friendly methods and the improvement of multi-purpose, energy-providing trees (black locust), as a means of rural development; the selection and improvement of plants and micro-algae with high fat and oil content, for the production of bio-fuel; examination of indigenous Hungarian domestic animals – especially the grey cattle and the Mangalica pig.
2. *Renewable energy.* This includes second- and third generation fuels, examination of the alternative raw materials of bio-fuels, the possible use of the by-products of energy industry, use of alternative energy sources in agricultural units, environmental, soil science and economic optimisation of energy plantations, the examination of the components of alternative bio-gas raw materials. On the whole, the issues of energy efficiency and saving, renewable energies, and climate protection are of utmost importance.
3. In *animal husbandry researches* central issues are the environment sustaining, protection and management aspects of animal husbandry and the development of ecological animal husbandry. In the future, R & D will focus on the development of extensive (and intensive) animal farming and foddering technologies, in order to safeguard the production of high quality raw materials for food industry.
4. In *forestry researches* the focal issues are the examination of the material and water circulation in the forest ecosystems and the exploration of the biotic reasons for the decay of forests. The researches of the near future will focus on the recognition through monitoring of the action of global ecological processes (including climate change the circulation of carbon), the monitoring of the characteristics of the wood composition of forests basically determining the operation of forest ecosystems (by the method of long-term experiments), and the working out of the criteria and financing system of sustainable sylviculture.
5. In the *field of fishing* issues of special importance are the structure and operation of water ecosystems, the development of water saving and environment friendly fish farming systems, and the mapping of areas endangered by topsoil water. The future researches will be carried out in the following topics in the first place: development of sustainable extensive and semi-intensive fish farming technologies, with special regard to multifunctional fisheries and bio-fish production; ecotechnology researches and the researches of sustainable aquacultures.

6. As regards the *mechanisation of agriculture*, the following topics will remain important priorities: energy production on biomass bases, the use of renewable energies in rural areas, the development of new generation bio-fuels, the working out of more efficient environment friendly spraying procedures, and the examination of the technical and technological correlations of environment protection and animal welfare.

The topics of the researches outlined above should of course be expanded, but this is strictly limited by the tight budget of the ministry. Among the tasks of R & D & I in the near future, a *shift of attitude and culture* would be necessary. This is closely related to talent management and the increase of the broad social recognition and acknowledgement of the ministry. The ministry sees a great possibility in the more intensive use of the EU resources. The more intensive participation of Hungary in the European Union actions in this respect would be necessary, as Hungary has to open to the world both from strategic and resource allocation considerations. In the EU, the financial resources targeted at research and development are huge from a Hungarian perspective. Within the community programmes, the calls for tenders in the fields of agriculture, food economy and bioenergetics are important segments.

Medium term strategic objectives – the environmental strategy of the MEW

The ministry of the environment has set the *medium-term* strategic objectives and directions, with a view to the environmental tasks in the 2nd and 3rd *National Environmental Programme* (NEP). The second programme defined the most important environmental tasks of Hungary until 2008. The implementation of the programme brought considerable improvements in the state of the environment: the different measures served the protection of the air, water and soil, but efforts were also made for the moderation of the environment damages caused by noise and vibration. An objective was to raise the proportion of renewable sources of energy from the 3.6% of that time to 5%. In the field of waste management, selected tasks were the decrease of the amount of waste produced, and the measures for the utilisation and up-to-date handling of the produced waste.

In the spirit of the Framework Convention on Climate Change signed in 1994, Hungary still aims at the stabilisation of the concentration of the greenhouse gases in the atmosphere at a level that would not pose a threat to the climate system. The work of the coming decades is built on the principle of *sustainability*. In planning, the aspects of environment protection will soon be just as important as the economic considerations.

Principles of the strategy of the Ministry

The R & D management system of the ministry is organically embedded into the selected strategic tasks of the ministry. The *comprehensive strategic planning* is built on three strategic bases:

1. *Sustainable development.* Sustainable development creates the possibility for the constant improvement of the quality of life in the broader sense. The strategy dealing with sustainable development is made on the possibility of influencing these factors and defines the desired future situation.
2. By the *medium-term strategy of the environment* the sensitivity to the issue of environment and the responsibility oblige the ministry to make a strategy that considers the fields in its competency – environment protection, nature protection, water management – as a single issue of environment, and is built on the strengthening of environmental consciousness and the eco-effective innovations, promoting this way the setting of Hungary on a track of sustainable growth. The 2nd NEP was finished in 2008. The ministry now has a double task: to renew the regulation of medium-term environmental policy planning, on the one hand; and the preparation of the 3rd *National Environmental Programme* for the period starting in 2009.
3. *National Climate Change Strategy* – scientific researches and analyses suggest that in the coming decades we will have to face significantly changing conditions of temperature and precipitation, the seasons will possibly shift, extreme weather conditions will be become more frequent and violent, which all will endanger the health and the quality of life of the population, natural values and built environment and the agricultural yields. Par. 3. of the Act No. LX of 2117, on the implementation frameworks of the Framework Convention on Climate Change of the UNO and the Kyoto Protocol to it, requires the making of a National Climate Change Strategy (NCLS), which has to be worked out for the first time for the 2008–2025 years. The implementation of the NCLS will be done by the – biannually worked out – National Climate Change Programmes.

Comprehensive strategic planning promotes, in addition to the above-mentioned, the strengthening of environment consciousness, and its further developments based on the more systematic consideration of the green aspects in the legal and economic regulation.

The situation of R & D (& I) in the ministry

The ministry of the environment does its best, in harmony with the beliefs of the science policy of the Government of Hungary, to promote research and development in its field of activity. The role of environmental research and development is especially important in the training of highly skilled and *environment conscious labour force* and in the development of their cooperation willingness. R & D & I has always been a field of special importance in the activity of the ministry. The Act on innovation that entered into force in 2004 brought a new situation for the state participation in the system of R & D & I, which set as a primary objective the foundation of the sustainable development of the Hungarian economy. In the making of the act the ministry had an active role.

The own programmes of the ministry and the programmes coordinated and implemented with other organisations serve the realisation of the science policy objectives set in the NHDP (described above) and the Hungarian Government. Tools of implementation are the own programmes of the ministry (National Environmental Programme I., II. and the NEP III under preparation), cooperation agreements (with the Hungarian Academy of Sciences, National Office for Research and Technology and the Prime Minister's Office), and the joint programmes coming from the EU membership of Hungary, in the competency of the ministry, launched jointly with the Ministry of Foreign Affairs and the National Office for Research and Technology (EU 6^{th} and 7^{th} Framework Programme, Hungarian Science and Technology Foundation). These programmes have close correlations with each other. The objectives are realised in different sub-programmes, projects and calls for tenders. In order to meet these objectives, the MEW has an active role in the following fields:

1. R & D & I in Hungary:
The ministry participates in the implementation of tasks coming from the science and technology policy activity of the Hungarian Government. This purpose is served by the further development and updating of the 2003 version of the environment protection, nature protection and water management R & D & I concept of the MEW. The approval of framework agreements to be made with the National Office for Research and Technology – similarly to the cooperation with the Hungarian Academy of Sciences – is underway. Of great importance is the coordination of the R & D & I topics launched from the earmarked provisions of the state secretaries, as well as the working out and implementation of the own research plans of the ministry and its organisations – depending on the MEW budget –, the development and operation of the R & D & I information systems linked to the Hungarian Current Research Information System (HCRIS).

2. International R & D & I:
An intensive state participation is needed in the organisation of International Technical Science Cooperations, with special regard to the promotion of the Hungarian participation in the EU Research, Technology-development and Demonstration Framework Programme (RTDFP). In the European Union research, development and innovation are a field of selected importance, implemented though the RTDFP. One of its tools is the establishment of the European Research Area by the member states, which will be the main platform of the implementation, coordination and financing of research and development activities done at the European level in the future. As a compulsory task coming from Hungary's membership in the Union, the provision of international R & D technical science tasks in the EU 6th and 7th RTDFP is the responsibility of the ministry.

Tools – forms of cooperation and resources

Forms of cooperation

As everywhere, also in environmental researches and education the role of regional elements is strengthening, especially the RDTC-s are gaining a growing importance.

Regional Development and Training Committees (RDTC)

The RDTC, assessing the labour market demands and the institutional possibilities of the respective region and looking at the relation between the demand for and supply of labour, makes recommendations for enrolments. In this decision, the regional needs of vocational training are defined, with the consideration of the economic needs of the given region, the data of the labour market demand and the decisions concerning the national enrolments. In line with these the RDTC makes a decision on the schooling rates and the professional directions, it determines the positions of the given professions (putting them into categories of growing demand or decreasing demand). In the enrolment plan it sets three categories: A (vocational training to be developed); B (vocational training to be maintained) and C (vocational training to be decreased). It makes recommendations for the vocational training development purposes of the region. The RDTC only decides on trainings in the framework of *school education*, those outside the school system are built on market basis. In a modular system the founding subjects are the same in several related vocational trainings, but the range of these is not as wide as it used to be. It is known that school system education is financed by the municipal governments maintaining the schools, while the training of technicians outside the school system is done on tuition fee basis. After the change of the legal regulation of vocational training, from September 2008 those training places can receive vocational training contribution that have joined associations with at least 1,500 persons. These are the regional integrated vocational training centres.

Knowledge centres

Knowledge centres are sectoral and regional attraction centres that intensively cooperate with industry and innovation organisations. Their operation strengthens the R & D activity of businesses, make the cores of regional clusters, speed up the technological and economic development of the regions, and improve the competitiveness of the country. The objective of the National Knowledge Centre Programme announced by the National Office for Research and Technology is to select and develop a few knowledge centres that are able to penetrate into a few niche markets and are suitable in their sectors of the implementation of R & D & I projects in whose financing business investors play a dominant role. The role of knowledge centres is growing in environment protection. This is proved by a growing number of examples. One regional knowledge centre of this type was founded in the Szent István University of Gödöllő; this organisation is looking for the responses to the environment protection and environmental industry challenges of the Central Hungary region. The objectives of the knowledge centre include the preservation of the natural drinking water assets of the region. In this programme the academics of the university cooperate with the Water Works of Budapest Inc. They seek the solution together for the protection of the water assets underneath the Szentendre Island, supplying the capital city with drinking water, and for working out environment friendly agricultural production methods that can be used above this water. Another complex task that requires a solution from the knowledge centre is the purification of the large amount of ooze saturated with poisons and its recycling for the improvement of arable lands. In this work the researchers of the university departments are partners of the practical experts of the Budapest Sewage Works Ltd.

The *Environment and Nanotechnology Regional University Knowledge Centre* was created at the *University of Szeged*, for the "Development of the integrated systems for the improvement of the quality of life in the South Great Plain". The focus of *environmental technology* researches of the knowledge centre is, in addition to the application oriented problems related to waste treatment and management, the establishment of environmental monitoring systems. In the sub-programme called *energetics*, one of the main objectives is the search for solutions for the improvement of the efficiency of the production technologies of bio-gas, bio-hydrogen and bio-ethanol from biomass by bio-technology methods; the other selected task is the solution of the utilisation of geothermal energy.

In the framework of the projects of the *Regional University Knowledge Centre of the University of Pannonia*, value-protection methods and tools are researched, developed and taught. The objective of the ÖKORET Environmental Safety Knowledge Centre within the University is the development of solutions with the full consideration of ecological aspects, the preparation of the application and the practical introduction of these solutions, and also the implementation of services promoting environmental technologies.

Regional innovation agencies

The National Office for Research and Technology announced a tender for the *support of the research and development and innovation activities of the Regional Innovation Agencies (RIA)*. The aim of the tender called support for the Regional Innovation Agencies is the strengthening of the National Innovation System, and the preparation and empowerment of the RIA-s for the effective management of innovation in the *regions of Central Hungary and West Transdanubia*. The national network of the RIA-s, in cooperation with the National Office for Research and Technology, wishes to support Hungary in economic development and innovation programmes. RIA-s have been established in all seven Hungarian regions. An important task is the creation of their national network that integrates the Innovation Agencies and the Office into a joint working organisation.

Clusters

In the general sense a cluster is a tool of *regional networking***,** looking at its concrete form it is the voluntary cooperation of businesses and organisations working in the same production chain. This involves all those businesses and institutions that are capable of increasing the value added in the value chain. The Hungarian businesses has to reach, by "clustering" and the more close cooperation with the research and university sector, the size that is needed for their competitiveness at a European level. In technology intensive manufacturing industry, the creation of clusters is of special importance. From this aspect, all efforts should be made for the establishment of clusters in the sector of manufacturing of environment protection tools and equipments. The recognition of this need is indicated by the birth of a growing number of clusters in the *environmental* industry. Such a cluster is e.g. the First Hungarian Alternative Energy Cluster. The goal of the companies engaged with the use of alternative energy integrating into one organisation is the dissemination of the knowledge on alternative energy and the promotion of the use of these energies in a circle as wide as possible.

The regional Association of the Entrepreneurs of Central Hungary and the Local Rural Development Office of Monor held the founding session of the *Environmental Technology Innovation Cluster* on 19 March 2009. The goal of the ENIN *Environmental Cluster* established in Miskolc is to promote the improvement of the state of the environment of North Hungary, a region with heavy industry past, and the growth of the innovation potential of the region, as a result of which innovative technology solutions can be applied in industry. In the field of environment protection and environmental industry, the *South Transdanubian Environmental Cluster*, in addition to its other tasks, builds out an international system of relations for its members, maps the available technologies and does joint trainings.

Regional research supports

As the development of financing has been analysed in details (see Chapter 3.), now only a table featuring the R & D expenditure by regions is used to demonstrate the present situation. It is clearly visible that the region of Central Hungary still receives approximately 70 per cent of the support resources (*Table 1*).

Table 1.

Number of research and development places and R & D budget by regions, 2007

Region	Number of R & D places		R & D expenditure			Expenditure per one research place		
	number	2000= 100.0%	HUF million	€ million*	2000= 100.0%	HUF million	€ million*	2000= 100.0%
Central Hungary	1,374	137.7	158,761	631.73	216.7	116	0.47	157.4
Middle Transdanubia	186	115.5	12,916	51.39	245.6	69	0.27	212.6
West Transdanubia	216	147.9	14,819	58.97	502.5	69	0.27	339.7
South Transdanubia	246	189.2	6,072	24.16	155.0	25	0.10	81.9
North Hungary	173	157.3	8,373	33.32	334.4	48	0.20	212.6
North Great Plain	335	135.1	20,446	81.36	251.1	61	0.24	185.9
South Great Plain	310	136.6	18,983	75.54	231.5	61	0.24	169.5
Total	*2,840*	*140.6*	*240,370*	956.47	*230.6*	*64*	*0.26*	*164.0*
Non-classifiable by regions	–	–	5,322	21.18	–	–		–
Grand total	*2,840*	*140.6*	*245,692*	977.65	*230.6*	*449*	*1.79*	*164.0*

Note: MNB calculated with the mean exchange rates of the NBH of 2007.
Source: South Transdanubian Regional Innovation Agency Ltd., Pécs.

Summary

Looking at the features of the environmental sector and its innovation performance it is obvious that the significance of the environmental sector is increasing – it is enough to think of the volume of environmental investments and the development of the proportion and value of environmental expenditure. Within these, the share spent on investments in sewage treatment is the highest. This makes the revenues of the environmental industry, the performance of the sub-sectors and the export revenues increase. In the improvement of the Hungarian environmental industry at the international level, a serious role is played by the export activity of the Hungarian businesses in the framework of the so-called KEXPORT programme. By the KEXPORT, export activity, knowledge transfer and investments in the environmental industry are promoted. The bulk of the Hungarian companies are integrated into two large sectoral associations (in environment protection it is the Association of Environmental Service Providers and Manufacturers – AESPM –, in water management the Hungarian Water Utility Association – Mavíz). As regards the situation of employment, the availability of experts and their age structure are unfavourable. In the provision of trainings meeting the demands of the sector, the role of the Regional Development and Training Committees (RDTC) is increasing.

The general situation of R & D in Hungary is characterised by a lagging behind the EU average, although serious initiatives have been made for making up for this deficiency (tax allowances, strengthening of technological incubation, increase of knowledge founding competitiveness, enhancement of the R & D & I capacity of the regions, support of the innovation activity of companies etc.). In the improvement of the general situation, the consistent implementation of the tasks and objectives set in the act on innovation plays a dominant role. This requires the improvement of the situation of financing. In the R & D expenditure, besides the decrease of the state participation there is a growing share of the contribution by the companies. Among the supports allocated for the R & D sector, most significant is the support provided by the Hungarian Scientific Research Fund – HUF 40–50 billion annually –, but the research sector is also given considerable supports by the New Hungary Development Plan (NHDP) as well. The award of the support takes place in open tender procedures.

The science, technology and innovation (STI) policy of the Government of Hungary is a part of the NHDP, broken down to different planning levels. For the realisation of the objectives the Government defined strategic principles, horizontal tasks, medium term strategic objectives, priorities and tools. The STI (action plan) for 2007–2010 was defined in a Government decision. In the management system of R & D at ministerial level, the role of the Ministry for

National Development and Economy and the Ministry of Education and Culture is dominant, but the managing role of the minister without portfolio, responsible for R & D ceased to exist in April 2009. From among the ministries interested in environmental researches, in addition to the Ministry of Health and the Ministry of Agriculture and Rural Development it is of course the Ministry of Environment and Water that has a leading role. Among the tasks of the latter, of special importance are the coordination of R & D at national level, the creation of the R & D & I strategies and tender systems, and professional support for the increase of the proportion of eligible resources. The medium-term strategic objectives of the Ministry are determined by sustainable development, the medium-term strategy of the environment and the National Climate Change Strategy (NCCS). The role of the Ministry in R & D & I is active both at Hungarian and international level.

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CONTRADICTIONS OF THE HUNGARIAN AGRICULTURAL AND RURAL DEVELOPMENT, WITH REGARD TO THE ASPECTS OF THE ENVIRONMENT

Attila Buday-Sántha

Situation of the rural areas and efforts for their development

The situation of the rural areas has been a recurring topic of conferences for a decade. The results, however, are too few; this is indicated by the development of the social and economic situation of the countryside. The fundamental reason for this is the depreciation of both agricultural production and the countryside after the systemic change. Those responsible for the management of agricultural and social policy saw agriculture as a sector continuously losing its weight and did not recognise the role of agriculture in the wider agro-business sector (manufacturing of tools + production + processing + marketing), and its multiplier effect on the performance of the national economy and on employment. The systemic change divided the countryside into winners and losers, and this internal tension makes any single interest representation impossible. Nowadays in Hungary the countryside means the following:

- low level of education;
- low level of employment;
- deficiencies in infrastructure;
- low quality and high price level of public services;
- lack of future scenarios, and helplessness.

Although the countryside has never been homogeneous, all of the above-listed problems are true for large regions. A significant part of these problems are traditional problems – such as the overpopulation of agriculture, low level of education, the lack of incomes, the deficiencies in infrastructure and public services –, but these negative phenomena were often extremely reinforced and deepened by the systemic change, especially by

- the decrease of local employment, which was a result of the reductions in agriculture and sylviculture and in local industrial activities, and which

contributed to the birth of long-term rural unemployment and low level of education, and the fact that the Gipsy issue became a central problem;
– the involuntary mobility enforced by the previous factors, for which neither the financial nor the infrastructure conditions are given;
– the change of the demand for level and type of vocational training, for the solution of which there is hardly any possibility in the short run.

The basic problem actually is that the economic foundations of the countryside were shocked by the systemic change and no remedy has been found for this situation since then. Of course there is no shortage of ideas. Many wish to solve the problems in Hungary with experiences gained in Western countries, forgetting that
– the economic power and international interest representation ability of the countries chosen as examples exceed by far that of Hungary, for example in the case of Austria;
– the purchasing power of the population is different;
– the level of education of the inhabitants exceeds that of the Hungarian population;
– the industrialisation of the rural settlements was actually completed there; and
– there are significant disparities in the level of infrastructure in the countryside.

This is why no solution is offered for the whole of the countryside by the following recommendations:
– *Rural tourism is the solution.* Yes, it is a solution – in settlements that have historical or cultural history attractions that make it worth travelling there and where the personal and material conditions of the reception of guests are given. These three conditions are given in very few places, in not more than 5 to 10% of the municipalities.
– *Handicrafts industry must be developed.* The most innovative ideas are raised, from the Gipsy village of blacksmiths through basket making to the training of Gipsies in marketing. Actually Hungary only needs a limited amount of handicrafts products. One of the main obstacles of the sales of these products is the low purchasing power of the population. Another problem is that the production of high quality, demanding folk art products was killed by the liberalisation of the activity, giving way to the industrialised manufacturing of products of inferior quality.
– *Bio-production is a solution.* Bio-production, besides integrated agricultural production, is a dominant method of modern agriculture, aiming at the

production of special quality (free from chemicals), which, however, has higher risks and lower yields, so it can only be done successfully if the goods produced can be marketed at 30–50% higher price. Because the higher prices of bio-foods limit their consumption, the market was soon saturated and now there is an over-supply of bio-products. Today the market of bio-products is a market just as competitive as that of the traditional agricultural products, where only those can survive who are able to produce bio-products at an above average technology level and expertise, in an adequate quantity, keeping the defined quality requirements and at lower costs than the competitors do. It is evident that this is not a way to go for the poorly equipped farmers with an average of 4 hectares of land, 92% of whom only have primary school education. This is also indicated by the fact that almost 90% of the bio-food produced in Hungary is exported – most of them as unprocessed raw materials – and the major part of this is produced by large farms doing bio-production, where the technology level, the adequate production size and the necessary professional and market skills are given. This is the case in the whole world, anyway, the average size of the bio-producers dominant on the market exceeds by far the average size of the farms in general (e.g. in the EU 15 average farm size is 19 hectares, that of the bio-farms is 40 hectares).

Farm size, however, in only one factor – similarly to traditional production –, the efficiency of farming is basically determined by the level of organisation of the whole product line (production–processing–marketing), which is one of the main problems of the Hungarian agriculture (not only bio-production) these days. The production structure of the Hungarian bio-farms is equal to the traditional structure, in 98% of the lands used for bio-production cereals (wheat, spelt wheat, barley, maize etc.), oil plants (sunflower, rapeseed, soybean, oilseed pumpkin etc.) and fodder are grown. The market of bio-products is a growing but limited market, which is also indicated by the stop of the increase of production in Western Europe, and the consumption of bio-products will not exceed 5 to 10% even in the long run.

– *The preservation of the village heritage and the keeping of the traditions is a task.* This is a very important objective, but the renovation of the village centres and churches, and their night lighting cannot hide the fact that the economic background of these settlements is missing and the prospects of life of the countryside inhabitants are far from favourable.
– *Energy production in the rural areas is the solution*. This is a possibility unutilised so far, which could offer a relatively cheap solution by the development of sylviculture and the use of the by-products of agriculture (straw, maize stem pellet, wood chips), in local power plants

and waste incinerators also using agricultural by-products, or the market-oriented production of bio-briquette. For the development of sylviculture, grasslands unsuitable for any other use (approximately 600 thousand hectares) are available, as are arable lands of lower quality (approximately 300–400 thousand hectares); however, the development of sylviculture is blocked by the low amount of support (allowing the afforestation of approximately 10 thousand hectares annually), the private ownership of the forests, and the fact that uncultivated grasslands are designated as protected areas, without any reason, and this way the restoration of the original forest ecosystems is hindered.

Nowadays the most popular forms of bio-energy production are bio-diesel and bio-ethanol manufacturing, which are subject to the requirements of international competition and their developments are dependent on the competitiveness of agricultural production, which makes it absolutely indifferent if e.g. fodder cereals or raw material for bio-ethanol is produced.

The recommendations mentioned above can all be important partial elements in the development of rural areas, but they cannot result in fundamental changes on their own. The task is much more complex and only those developments can be solutions that meet the present requirements of the competitive market. The problem of the majority of these solutions is just that they try to avoid the competition in effectiveness, but in the modern socio-economic life there is no field where this is possible in the long run, because competitiveness is a prerequisite of long-term survival and material well-being – the complex economic and social development of the rural areas is thus indispensable. This means that the following approaches are completely wrong:

- Liberal: central developments will filter down to the countryside. Well, the last decades proved something completely different. The effect of the central developments might have been visible in the agglomeration zones and was only good for attracting population into these areas.
- Folk-romantic: this attitude considers the traditional peasant way of life and production means as the basis, and tries to reconstruct them. The representatives of this view tend to forget that the young – especially women – want to live just like their urban counterparts and not like their grandparents. It is impossible now to live that way, anyway.
- Eco-romantic: the representatives of this view overrate the role of the natural environment in people's lives, their only objective is the expansion of the protected areas, which slows down the economy; they consider countryside humans as happy natives managing the landscape. Their activity aims at the preservation of the land use; in fact, under the slogan of

> nature protection they want to change cultivated lands into natural landscapes by creating primal forests and marshes. Their activity is definitely harmful now in many cases, blocking the rational development of areas. Their violent actions regulate those local inhabitants whom they should rather thank for the very survival of the natural values, and this aggression cannot even be stopped by the management authorities, mostly due to their deficient environmental protection skills. The point is that these obsessed beings, absolutely indifferent to the socio-economic requirements, would like rural people to live on reservations – which they do not want.

For the rural areas, both the total lack of attention and the unrealistic, wrong development directions (folk-romantic and eco-romantic view) are a danger.

The role of agriculture in rural development

A recurring statement of today is that the countryside is not equal to agriculture! This is true, but it is also true that no countryside can exist without agriculture! This is not only because agriculture is one of the most natural bases of the rural economy, and is exclusively linked to the rural areas but also because all those services that the rural areas can offer, besides food and raw material production (managed landscape, cultural landscape, diversity of the wildlife, rural culture, traditions etc.), are inseparable from agriculture and sylviculture. Agro-policy representing agriculture – in the modern sense of the word – is a sector of economic policy whose task is the provision of the society with food and industrial raw materials, and energy, the preservation of the living standards of the labour force agro-economy and the international competitiveness of the sector, the preservation of the cultural conditions of the landscape and the protection of the natural elements and the bio-diversity.

Because the endowments of the agro-economy are excellent in Hungary, it is astonishing how much the representatives of the politics and economy underrate agriculture and how indifferently they watch the deterioration of the sector that has been going on for two decades. A recurring justification of this attitude is that agriculture does not have a significant proportion from either GDP or employment (approximately 3% and 4.8%, respectively). This of course is not true in this form, because agriculture is the foundation of the agro-business, on which foundation several activities are built from the manufacturing of production tools (mechanical engineering, chemical industry, glass industry, plastic industry etc.), the processing of agricultural products (food industry, wood industry, textile industry etc.), services provided for agriculture (education, research, management) right to the wholesale trade and retail trade of agricultural products and foods, in fact, beyond that to public catering and restaurant services. The share of agro-business from both GDP and employment reaches 10–20% now even in the most developed countries. A good example for this is the most industrialised country of Europe, Germany, where agriculture only employs 0.8% of the workforce but the share of agro-business from GDP reaches 12-14%. These figures are even much higher in the USA. It is not well-known that the largest industry in the world and in the European Union is food industry and not car industry, and food industry is still dynamically developing, which is proved by the position of the European Nestlé or the Unilever companies in the rank of the biggest companies of the world.

When we see the depreciation of agriculture and the wasteful use of valuable agricultural lands, we can clearly see the short-term view of the managers of economic policy. They keep forgetting that food and water are the most important strategic products and the supply of the world with food in the future is far from being safe. Today there are approximately 850 million people who starve (and the number of those suffering from malnutrition may reach 2 to 3 billion), and the population of the world will increase by some 2 billion even in the best case, the size of arable lands is dramatically decreasing, and the growth of the agricultural yields has slowed down.

Agriculture can only offer the services required by society if it is a viable agriculture, a prerequisite for which is the international competitiveness of the sector. The determining factors of the competitiveness of agricultural sector are *production size*; the *level of production (technology)*; the *skills of the producing labour force*; and the *organisation level of the production at the level of the national economy*.

The contradictions of the situation are well reflected by the fact that now in Hungary the average farm size is nine hectares, and that of the private holdings is four hectares. For such a large number of such small farms it is impossible to create economically operating modern technology systems, and even if it happened by some miracle, the specific costs of the production would be unbearably high. The improvement of the present situation, however, is blocked by the extreme selfishness of the farmers and total lack of cooperation willingness.

In the 21st agriculture is an engineering science, in fact, in many respects it requires specialised engineering skills; it has to safeguard the profitability of production, food safety and the protection of the environmental elements, of nature at the same time. Today in Hungary 92% of the farmers have primary school education or even less. However, even if all conditions were given – farm size, technology level and trained human resources –, the effective operation of the sector would be made impossible by the lack of organisation – or counter-interests – of the products lines at the level of the national economy, which is one of the main problems these days.

In the case of the rural areas, the systemic change was the victory of the ancestors over their descendants. In other word, the victory of the past over future:

- It disintegrated the competitive structure of Hungarian agriculture, and Hungary now is in the bottom of the rank of the European states with its farm structure. The number of farms in Hungary was 625 thousand in 2008, cf. 460 thousand in Germany and 50 thousand in Denmark.
- Systemic change disintegrated the individual phases of the product lines and made them counter-interested (agricultural production – processing – marketing), and in many cases sold agriculture to foreign competitors or Hungarian financial investors who were not interested, beyond the immediate profit, in the long-term preservation of the sector in (see e.g. the deterioration of the Hungarian sugar or poultry sector).
- The systemic change divided the rural areas into winners and losers, so there is no single interest representation, there are only partial representations that are contradict each other in many cases.
- Systemic change decapitated the intellectuals knowing the rural areas and dedicated to it, formerly working in the large-scale agricultural holdings (agricultural engineers, horticultural engineers, mechanical engineers, lawyers, veterinaries etc.), and the lack of these experts can be badly felt in the definition of the rational, adequate development directions for the respective regions. It is not a solution and cannot be very successful if tender-writing offices in Budapest or the large countryside cities make the development plans of the respective settlements.
- Systemic change created the possibility of continuous withdrawal of incomes from agriculture by the system of 60% leasing , which does not only block and jeopardise the development of production but also allows a significant part of this income to get to urban land owners, instead of improving the living standards of the village inhabitants.

The problem of agriculture is not that employment in the sector fell to 4.8%, to approximately 180 thousand people, because if we consider labour time spent on agriculture, including the auxiliary activities and the work done in the homesteads, we would get approximately a double of this; the problem is that the productivity of agricultural work is extremely low in Hungary by an international comparison, and agricultural employees now have to work in Hungary for approximately 60-70% of the national average income. Because of the low productivity of agricultural work and the high own costs of production in agriculture, agriculture is continuously losing its markets and this leads to a further decline in employment. However, this is not an automatic process; this is the consequence of the crisis of Hungarian agriculture going on for decades. If we try to find the lost competitive workplaces, we find the answer in the development of employment.

Table 1.

Development of cattle and pig breeding, of viticulture and wine production, 1990–2008

Activity	1990	2008	Decrease	Loss of jobs
Cattle breeding	1.6 million	0.7 million	-0.9 million	50 pcs/capita 18,000 jobs
Pig breeding	8.5 million	3.9 million	-4.6 million	500 pcs/capita 9,200 jobs
Viticulture and wine production	130,000 hectares	80,000 hectares	-50,000 hectares	2.5 hectares/capita 20,000 jobs

Source: Edited by the author in the basis of HCSO data.

If we only look at these three sectors, we can see the loss of almost 50 thousand jobs, but reductions were made in almost all labour intensive sectors. The consequence of this is the simplified and low value added production structure, whose main features and consequences are as follows:

- overweight of cereals and oil seeds,
- decline of animal husbandry,
- export of unprocessed raw materials, often in inferior quality that is easily substitutable on the market,
- loss of the markets of agricultural products,
- import parallel to the loss of the domestic market, as a consequence of which Hungary has become a net importer of basic foods (dairy products, pork, fruits, sugar).

To the crisis of the Hungarian agriculture – for which ourselves are to blame in the first place – we wrongly expected the solution from the European Union, hoping that we would become part of a large market and that the support of the Union would help us in the fast catching up of our technical underdevelopment. Unfortunately it soon became evident that the production level and the organisational level of the Hungarian agriculture do not allow Hungary to have a position in agriculture that the endowments would allow. The catching up of the technology and the increase of the production of the Hungarian agriculture – which is impossible with the present ownership pattern and the counter-interested product lines anyway – does not match the interest of the old member states of the Union, as it would increase competition for them.

Franz Fischler EU commissioner made it clear in his statement: “The Union is not interested in the utilisation of the agricultural potential of Eastern Europe”. Due to this and the counter-interests and economic difficulties of the old member states, the Union is not up to a catching-up of the new member state (EU 12) that it was up to formerly, in the case of the Mediterranean states. As opposed to the increase of production, the Union is much more interested in rural development, the maintenance of the (quasi) natural landscapes, the preservation of the biological diversity, i.e. in all those that are missing in the old member states and do not mean economic competition. This explains among other things why the Union is not so much keen on the opening of the land market of the member states acceded in 2004, as that would necessarily lead to the increase of production.

The socio-economic foundations of rural development

György Enyedi and József Nemes Nagy already expressed as soon as in 1993 that the catching up of the rural areas in the future cannot be expected from agriculture in the first place. This does not mean of course that the present and even more so the future potential lying in agriculture should be depreciated. The solution, however, is extremely hard, and we cannot expect any change now that would lead in the short or middle run to the considerable increase of employment. We cannot hope that, similarly to Western Europe, industry will locate to rural small towns and larger villages and will solve the employment of the masses of less schooled rural inhabitants (to the opposite, even what the Hungarian countryside had has been liquidated: canning factories, poultry processing plants, cooling facilities, textile plants, sewing plants etc.), and will offer an attractive career for the young generation. Such industrial activities either migrate to the Far-East because of the even cheaper labour force or concentrate in cities, because the industrial sectors of the larger cities do not actually require more than elementary schooling either, as the majority of the labour force are semi-skilled workers.

Taking all this into consideration, the improvement of the situation is an extremely difficult task; this necessitates both internal and external resources, in special combinations in each sector. It is of vital importance that these developments should be well-established economically, because it is impossible to have for example 8 to 10 profitably operating thermal water baths with medicinal hotels in each Hungarian county. The failures of the baths located on one single factor, thermal water, are already visible and will be even more visible in the future. The principle that we need developments, whatever they are, will lead to the masses of demonstrative investments without any real economic development impact – apart from the use of EU resources –, and in the lack of profitable operation, their deterioration will start at the very moment of the launch of operation of these establishments.

The improvement of the situation definitely requires the improvement of the schooling and mobility of the inhabitants. The unfavourable experience of the last two decades was that the small schools were unable to offer a modern training, despite the small number of pupils. Modern education requires central schools where all conditions necessary for education (skilled teachers, catering, sports halls and sports fields with adequate sanitary establishments, library etc.) are given. When the municipalities fight for their own schools, what they consider the least is just the future of the children in most cases; they sacrifice the future of the children to the short-term interests of the settlement or some people, and most of the times it is not even mentioned what the interest of the age groups of 1 to 6 years or older 14 is. Neither a crèche nor a kindergarten can be operated at an adequate quality at local level (in small villages), only if the establishments are centralised. What every village needs is not a school but a community house that can be a meeting place of the elderly people in the daytime and of the youth at night, and where the teachers and cultural managers moving into the educational centres and rented apartments can organise high-level cultural and sports programmes, for several villages if necessary.

An important prerequisite of the improvement of the living conditions of the village population is the increase of the mobility of the people. This task can mainly be solved by the villages by the use of minibuses adjusted to the timetables of the mass transportation, and the village caretaker service operating these buses. Serious employment, education, health care and administrative problems are caused by the lack of roads connecting villages not more than 3-5 kilometres from each other, making travel from one village to the other unbearably long, often with 10-20 km detour. A key issue of rural development is then the construction of roads connecting the settlements. This is also an interest of agriculture, as the improved transport conditions will significantly improve the conditions of production; the costs of agricultural production will decrease, as will the costs of public transport – transport in the dead-end villages cannot be organised economically, it is extremely expensive.

The rural areas require intellectuals living and working in the countryside. A number of Hungarian examples demonstrate that those settlements are developing and are void of crisis phenomena where a well-prepared person was able to define realistic development objectives for the community and where these objectives were implemented by joint efforts. An intellectual will only move to a village if s/he gets an adequate home, if s/he considers the services for his/her children (crèche, kindergarten, school, leisure facilities) acceptable and if s/he has adequate choice of jobs and mobility. What the rural areas need is not intellectuals commuting from the cities but intellectuals living in the villages and experiencing the impacts of the developments personally. We do not need martyrs who, if they lose their only job, will find themselves in desperate situation in lack of new jobs, who are unable to sell their real estates built with sacrifices and who are unable to move.

The tasks of rural development are very complex then, and their implementation requires conscious efforts for a long time. It is a basic issue what should be done until then to the masses of people, the generations succeeding each other who are caught in the villages, without jobs and development possibilities, and whose number is increased year after year by the decline of agriculture. The possibilities are very few. For those leaving agriculture, the EU offers the early retirement scheme. For the larger number of people, a possibility given since the beginning of the systemic change would have been – and still is in the future – the very much needed water-works and the afforestation of the hundreds of thousands of hectares of lands left uncultivated. Afforestation has never been adequately treated by the ministry of agriculture, which is indicated by the fact that the Hungarian government promised at the Rio Word Summit the plantation of 150 thousand hectares of forests until 2000, of which only 62 thousand hectares has been done to date. The present pace of afforestation is unsatisfactory too; it should reach a minimum of 15 to 20 thousand hectares annually. This would serve several purposes at the same time: environment protection, the improvement of the landscape, and could create a significant economic basis for some regions.

Afforestations are blocked by the fact that forestry companies, where expertise and technology are given, cannot buy lands, also, in many cases environment protection is an unreasonable barrier to afforestations. It would be very important to locate community forests with communal work in many smaller derelict lands (uncultivated gardens, vineyards, orchards or vegetable gardens). Since the systemic change and the privatisation of forests, the condition of the forests has been continuously worsening and the recovery would require a lot of work; it would also bring significant economic results. It is basically the central incentives that are to blame for a contradiction: the more serious the lack of jobs and unemployment in a region, the larger the unutilised or poorly utilised areas.

Rural development cannot be solved by the separate development of each settlement, only by the harmonisation of the development objectives. It seems that the forces and promotions to support coordinated developments are still too few, and the unnecessary rivalry among the mayors can block the process. Even in the majority of the developments implemented from central resources and EU supports, regional view and the effort to solve a problem at international level are often missing. What is in the centre, instead, is the solution of local problems at a level allowed by the given situation, often leading to several and in many cases unreasonable, low quality and in the future unsustainable developments. The uncoordinated and fragmented developments have no synergy effect at all. Among the reasons for this situation we find the disparities across the development resources of the municipalities, and also the fact that the calls for tenders do not require regional collaboration as a primary condition. The view that measures the success of development not in the solution of tasks but in the creation of establishments is also to blame.

In addition to the accumulating unfavourable phenomena, we cannot neglect the rebel of the municipal leaders and their strengthening cooperation to tackle the ever deepening crisis situation. The strong action of the mayors is needed to question the way of life based on benefits and crime and the forms of loan sharking done legally by the financial institutions and illegally – but unpunished – by the local criminals. These actions, coming from desperation and spurred by the local tensions, proves the vitality of the rural areas and the fact that they see future in honest work; the economic and political leaders of Hungary have to provide development programmes offering realistic scenarios for the realisation of these objectives, and support.

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THE IMPACT OF EU-EMISSIONS TRADE SHEME ON THE DEVELOPMENT OF ENVIRONMENTAL INDUSTRY SECTOR

Viktor Varjú

Abstract

Since the 1990s climate change and global warming have became significant topics in sciences and on policy level as well. International organisations[1] and following them also the EU (under the Kyoto Protocol) tried to find tools in order to reduce the emission of greenhouse gases while the economy does not meet with losses. On the other hand environmental problems (e.g. waste, emissions, other contaminations) and environmental protection (prevention) actions have generated formation of new technologies (Best Available Technologies – BAT), productions, know-how, state-of-the-arts, and have created another segment of the environmental industry sector.

Does the new policy have impact on environmental industry sector too? How can a policy – which is quite ambiguous – affect on the sector? Does it promote the use of clean (BAT) environmental technologies/technology transfer in affected enterprises generating the development of environmental industry sector with or do the affected enterprises use their "economic knowledge" to solve the problem caused by EU Emission Trade Scheme (EU-ETS)? In this paper – via the conception of technology transfer – (using four case studies) I argue how a policy intervention EU-ETS and Joint Implementation Mechanism (JI) can or cannot influence to the development of environmental industry sector.

Introduction

Current prognoses predict a rising of global temperature of an average of one to six degree Celsius till 2100. The increase within the last 100 years already amounted to 0.7 degree (*Gowdy,* 2008). Climate change is expected to result in increasing desertification, storms as well as floods and thus poses a huge danger for the environment in general and for the biosphere in particular. The economic instrument of emissions trading, whose origins will be exposed in the following, became dominant in the regulation of this problem (*Fahrner,* 2006).

Concerning Berg and Ferrier (1998) environmental industry – among others – 'includes all revenue-generating activities with (1) environmental regulations; (2) environmental assessment, analyses and protection; ... and (5) technologies and activities that contribute to increased energy and resource efficiency, higher productivity, and sustainable economic growth (enabling pollution prevention)' (*Berg–Ferrier,* 1998, 13). Having regarded this definition the *environmental protection* tools of CO_2 emission reduction (based on Kyoto Protocol – KP), the regulation of emission trading *generate revenues* on the side of sellers and indicate *technology innovation* (in order to reduce the emission) that contribute to *resource efficiency* and *sustainable economic growth*.

Per se investments towards a low-carbon economy must enable reductions in emissions of greenhouse gases. The amount of investment in emission abatement in general generates hundred billions of euros in addition to business-as-usual capital expenditures (*Cameron – Blood,* 2009).

Paying regard to emission trade we can distinguish two different ways of thinking/influence on environmental industry sector (EIS). The *direct* way is when the revenue of sold allowance is turning back to the EIS[2]. On the other hand, *indirect* way is when the obligated actor (firm) in burden-sharing make technology innovation (or use Best Available Technology – BAT) in order to avoid loss (purchase of quota), or generate profit (selling the remaining quotas resulted by the use of BAT or innovation).

Through four case studies on the application of KP I present, how a new policy tool can influence the development of EIS in different ways. The paper is mainly focused on the influence of technological innovation and R&D instead of the influence on mass production since KP and its implementations EU-Emission Trade Scheme (EU-ETS) (and also Joint Implementation – JI) is a new policy tool, generating new technology and R&D in the field.

Emission trade vs. economic development

Renewable vs. fossil energy sources

After several years of vocational debate and more than 5 years preparation, on the third summit of Convention of the Parties (COP) the Kyoto Protocol was born in December 1997 (*Lesi – Pál,* 2005). The launch of the system was not was not free from contradictions, since in 2001 US declared that they do not want to be involved in the KP, while Australia – as a huge emitter – ratified the pact only in 2007.

Standpoints can be understandable partly, if we approach from the side of economics. In the last two decades, parallel with the technological development and intensive economic increase, the amount of the use of energy also rose, not only nominal but proportional trend as well. Despite this trend, Table 1 shows that the extraction could keep step with the consumption, since data show, the availability of the actual extractable fossil energy stock in the timeline – although did not rise – was the same. Hence fossil stocks in a medium term will be available.

Table 1.

Extractable fossil stocks (in years), counting with the actual amount of extraction and consumption

	1975	2000	2005
Oil	36 y	41 y	41 y
Gas	47 y	60 y	67 y
Coal	218 y	230 y	230 y

Source: Pál, 2006 and Lomborg, 2001.

There are several other ratios besides the use of fossil energy. In addition to the fact that the cheapest energy source is the coal, using our recent knowledge the world energy consumption cannot be provided by the use of renewable energy only, because these energy carriers are not suitable for mass production. Therefore renewable energy is mostly good for supplementary purposes (*Rudlné Bank,* 2002).

Therefore the mutual institutional settings for the production and use of renewable energy, hereby the policy tools of CO_2 reduction are not efficient enough. As Lomborg, B. (2001) counts at the millennium, the emission reduction mechanisms of KP are enough for the reduction of 0.15% of CO_2 reduction by 2100.

So the extractable and cheap fossil fuels are not impelling the world-power countries to change their energy structures for a climate friendly one. Since the industrial developments are restricted into technological innovation and R&D.

Regarding the above mentioned it would be wrong-headed step not to focus on climate change. The reason is (if we only focus on the emission of CO_2, and skip the other environmental and air contamination of the use of fossil fuel) that the carbon absorption of the geo-sphere is limited.

As shown in Table 2 about 4,000 gigatons (109 tons) of carbon are stored in the atmosphere, forests, soils, and the upper ocean. There is much more carbon in the deep ocean, but this does not interact with the rest on a timescale relevant to this discussion (*Kasting,* 1998). About 5000 gigatons of carbon is stored in accessible fossil fuels, compared to 750 gigatons in the atmosphere. About one-half the carbon released by fossil fuel burning ends up in the atmosphere. Deforestation also releases carbon and recently this activity contributes about one third of the annual human-caused additions to atmospheric CO_2. The burning of petroleum and natural gas is a major problem since there is more carbon stored in these two fuels than there is in the atmosphere, but from Table 2 it is clear that the biggest problem is coal. About 80 percent of the world's fossil fuel carbon reserves are in the form of coal. Known coal reserves contain about five times as much carbon as is now in the atmosphere. If most of these reserves are burned without CO_2 controls, the results will probably be severe (*Caldeira – Kasting,* 1993).

Table 2.

Carbon in the environment and carbon stored as fossil fuel

Reservoir	Size (gigatons)
Atmosphere	750
Forests	610
Soils	1,580
Surface ocean	1,020
Deep ocean	38,100
Total active carbon in the environment	3,960
FOSSIL FUELS	
Coal	4,000
Oil	500
Natural gas	500
Total fossil fuel carbon	5,000

Source: Gowdy, 2008, adapted from Kasting, 1998.

The above mentioned facts show us that the CO_2 control is crucial. Although the Kyoto Protocol is not unambiguous its mechanisms – including the EU-ETS – can facilitate the reduction of carbon-dioxide emission, especially if this year summit on the reformation of Kyoto Protocol (which will be held in December 2009 in Copenhagen) results a better mechanism. The key factor here is the economical pressure – since the carbon-dioxide emission is a new factor/cost of production for firms, which can be a scant good – which can generate technological innovations in the EIS.

2.3. The EU-ETS

Kyoto Protocol has 4 flexible mechanisms. They are the bubble, (Article 4.1 UNFCCC [1998]) the joint implementation JI (Article 6.1 UNFCCC [1998]), the clean development mechanism (CDM) (Article 12.2 UNFCCC [1998) and the emissions trading (ET) (Article 17. UNFCCC [1998]).

Joint Implementation (JI) allows industrialized countries, who got binding Kyoto targets (Annex-I-Countries) to charge reductions of greenhouse gas emissions which they effected in other Annex-I-Countries, e.g. by technology transfers, with their own emissions-credits. The recipient countries' emissions credits are accordingly debited. This procedure is allowed by the KP from 2008 – the beginning of the first trading period – on. The basic idea of JI – in line with the concept of emissions trading as a whole – is the decisive insight that the concrete place where greenhouse gas emissions are reduced is not relevant for global climate and they are thus best achieved, where this is possible at lowest costs. This instrument gives incentives for states with a high level of technology to transfer this knowledge to technologically less advanced countries.

Clean Development Mechanism (CDM) as well poses the possibility of investing abroad in the reduction of greenhouse gas emissions to industrialized countries. In this case however the potential recipient states are developing countries with no own Kyoto obligations. Since the investor is anyway allowed to charge the achieved reductions against its own emissions credits the CDM contrary to JI results in an increasing of the total volume of emissions permits. The CDM has been possible from 2000 on. Since the reduction of greenhouse gas emissions in developing countries is cheaper to achieve than in industrialized countries due to their lower level of technology, the CDM shall – just like JI – maximize the cost efficiency of emissions trading.

KP introduced International Emissions Trading (IET). Compared to earlier approaches to emissions trading this is up to now the most far reaching one, since it is not limited to single nation states but allows trading across their borders. This fits to the logic of the problem of climate change again because of the notion of negligibility of the actual place where emissions reductions take place and because of the need to find a global answer to handle this problem.

In 2001 EU decided that Brussels will be active partner in the implementation of Kyoto Protocol. To implement the KP the EU developed its own emissions trading scheme (ETS) which is up to now the most far reaching trading system in the world. The Council of Ministers agreed on a common position in 2002 and found a compromise with the European Parliament (EP) in 2003, so that the EP agreed to the proposal at July 22nd 2003 in second reading. The agreed directive 2003/87/EC came into effect with its publishing in the

EU's Official Journal on October 25th 2003. It determines the frame, in which European emissions trading takes place, and authorises the member states to develop National Allocation Plans (NAPs). By these each utility and producer regulated by the EU-ETS is assigned with a number of emissions rights so that in sum the overall reduction goal is achieved. The rights are usually assigned after the principle of "grandfathering", i.e. they are distributed for free. The member states however had in the first European trading period the possibility to sell up to five percent of the whole amount of rights at auction. In the second period beginning with 2008 up to ten percent of their rights per member state can be auctioned (COM 2003/87/EC, Article 10).

According to the directive the processes of developing the NAPs must guarantee adequate consideration of comments made by citizens (COM 2003/87/EC, Article 9, Par. 1).

The EU ratified the KP as a unity, where a common reduction target of eight percent was assigned. Internally the member states agreed on a distribution of reduction obligations after the principle of "burden sharing". This allows for individual emissions targets of EU member states depending on their industry structures and per-capita consumption. Each member state is thus internally assigned its own target in a way that in sum results in a reduction of eight percent for the EU as a whole[3].

As a leader in international climate politics the EU decided to implement emissions trading even sooner than the KP prescribes. Till 31st December 2003 directive 2003/87/EC had to be transformed into national law so that with January 1st 2005 the first trading period, ending with 2007, could start. It will be directly followed by the four years long second EU and first Kyoto trading period. After directive 2003/87/EC the EU also integrated the flexible mechanisms, the JI and the CDM, into the EU-ETS with the so called linking directive 2004/101/EC (*Fahrner,* 2006).

The role of technology transfer

Concerning Ockwell, D.G.[4], there are four ways how to react to the challenge of climate change. They are mitigation, adaptation, financing and low-carbon technology transfer.

As Freeman, C. (1992) emphasises, technological change occur through either incremental or radical innovations. Innovations can occur when new inventions emerge, often as a result of deliberate R&D that leads to the renewal of old technology (*Ockwell, et al.,* 2008). Since technological change and technology transfer can contribute to the development of industry sector.

The main aim of low-carbon technology transfer is to cut down the "peak" of the Environmental Kuznets Curve[5] since we do not have to wait for a higher state of the GDP in order to achieve a lower emission. Although low-carbon technology transfer has several question marks (e.g. Property Rights, knowledge acquisition, few empirical evidence on how low carbon technology transfer might effectively be achieved) (*Ockwellet al.,* 2008), however, the low-carbon transfer itself generates the development of environmental industry sector. Certainly, the development can be achieved on side of developed countries. Ockwell, D. G. et al. (2008) also argue that less integrated technology transfer arrangements are more likely to involve knowledge exchange and diffusion which can contribute to the development of environmental industry sector in recipient countries.

Ockwell, D.G. et al. (2008) also argue that in developed and developing countries a clearly defined and properly enforced policy (i.e. tax policy or emission trading) will also have a key role in encouraging investments (*Ockwell, et al.* 2008).

On the side of economics, climate change is a multi-decadal challenge – not only in the sense of the Greenhouse Gases (GHGs) atmospheric circulation. So that near-zero CO_2-emmitting technologies be launched in the market over the next couple of decades – with that enabling to play a significant role of the EIS in this segment –, 50 years or more are needed to fundamentally transform the energy system because of the slow rate of turnover of the capital stock (*Grübler,* 1998).

Case studies

What does the real world say? Can the EU-ETS generate the wide range use of Best Available Technologies and technology transition that contributes to the development of environmental industry sector? Having briefly reviewed some of the relevant literature on the potential linkage between EIS and emission trade, now I turn to the analyses of four case studies.

The German case[6]

In Germany the EU directive on emissions trading was implemented with the law on greenhouse gas emissions trading (Treibhausgas-Emissionshandelsgesetz, TEHG), which came into force on 15 July 2004. All operators of power plants with a combustion heat performance of more than 20 mega watt as well as energy intense industrial plants now have to engage in the trading process to fulfil a certain reduction target for CO_2 emissions.

The German case study on emissions trading deals with the plans of the energy provider E.ON to modernise the power plant location "Staudinger" where three older plants should be supplemented by a new coal-fired power plant.

The considerations on the first decision must be regarded as strongly connected to the implementation of the European directive on emissions trading (Directive 2003/87/EC), since that the future competitiveness of black coal compared to alternative fuels (e.g. natural gas) will be strongly dependent on the development of the costs for CO_2 emissions certificates.

The power plant location Staudinger is situated in Hesse close to the city Hanau within the municipality Großkrotzenburg directly at the river Main. It currently has five power generating units. Four of them are fired with black coal and one of them, unit 4, is run by natural gas. Unit 2 has been in stand-by reserve since 2002. As unit 1 and 3 it is intended for medium load power generation. Unit 4 covers mainly minimum load while the natural gas burning unit 6 covers maximum load. The units all together have an output of 1,750 mega watt. They were put into operation between 1965 and 1992. In 2012 units 1 to 3 will be obsolete and therefore shut down.

The planned unit 6 is intended to start energy production in 2012, as E.ON frames it to replace the obsolete units 1 to 3. Since the new unit is supposed to cover minimum load block 4 would then be switched to medium load. With unit 6 (1,100 mega watt) replacing unit 1 to 3 the overall capacity at the location would be doubled up. Twenty-five percent of the unit's energy will be owned by the Stadtwerke Hannover GmbH and will thus be transferred to Lower Saxony.

E.ON first mentioned the possibility of building a new power generation unit at the location Staudinger in April 2006. By that time E.ON had an internal competition for the location of the planned power plant. Today E.ON argues that the location Staudinger is the best possibility because it is close to the consumers, it has a well trained staff, as well as a good infrastructure at an already developed power plant location. During the internal competition also another aspect was decisive: according to the Frankfurter Allgemeine Zeitung (FAZ) the director of the power plant at the location Staudinger emphasised from the beginning on that the internal decision also depended on the acceptance or non-acceptance of the project in the region. A positive attitude towards the projects within the region was for E.ON one of the preconditions for a decision on the location Staudinger. There was however little attention among citizens or local parties when the possibility of the new unit 6 was first announced by E.ON.

E.ON expected an uncomplicated permission procedure according to the BImSchG. However after the initial silence several action groups against the project emerged in the municipalities surrounding the location. On 28 March 2007 they joined their efforts with the foundation of the common Civil Action Group "Stopp Staudinger – Klimaschutz statt Eon-Schmutz".

The building of the new power plant is itself referred to as a project by the involved actors. It is related to a second project of E.ON, the building of two new coal bunkers. Before the decision on the location for the new power plant was made, the plans on the coal bunkers were introduced by E.ON as a precondition for an expansion of the power plant location. However the enterprise claimed that the building of the plants could not be interpreted as a guarantee for the building of the new power generation unit at that location. The new unit is supposed to be located where today the coal is stored. The building of the new coal bunkers demanded a change in the regional plan to which, with exception of the Greens, all had agreed. According to the FAZ E.ON had before bargained that a denial of this change would endanger the whole location on which many working places in the region depends (*Fahrner,* 2008).

Although the original research analysed the different relationships among the actors and stakeholders we can draw some conclusion relating to the EIS. As the case shows us, the dominant behaviour was the clean economical cogitation which did not result in clean or best available technology therefore it did not generate the development of EIS relating to the new policy tool. EIS only appears in a conservative way, when its products are used in environmental production and "conventional" emission reduction.

The Hungarian case[7]

In Hungary Pannonpower is the second biggest power plant in the South-Transdanubian Region (after the Paks Nuclear Power Plant which is the first in Hungary not only in the region). The firm has continuously been changing their technology in order to achieve a better dust emission rate. The fuel of the power plant was coal until 2004 but responding to the challenge of global climate change and regional air pollution they change their blocks to gas and biomass (as it has been mentioned). These changes are not only because of the economic efficiency. Until the system change the power plant had not economic interests to invest in filtering. The big pressure came from the near society, from the inhabitants of the city council and because of the unhealthy air of the city.

Concerning the new strategy of the Pannonpower Company until 2010 they would like to build two other biomass blocks with 35 MW and 50 MW built-in capacities[8].

Having gained favourable experience and knowledge in operation of biomass firing power plants, Pannonpower Group has just decided to implement a new biomass firing small scale power plant for the purpose of electricity and heat energy production from renewable energy resources.

In 2004 gas and biomass (one biomass (wood) block with 50MW built-in capacity) came out as a fuel. The change resulted in less pollution of sulphur, nitrogen-oxides, and reduced the gross carbon-dioxide emission as well. These mitigations are measurable in the air quality of Pécs and also appear in the competitiveness of the Pannonpower. (The changing from fossil to renewable fuel resulted that Pannonpower had successful transaction in Joint Implementation procedure in 2004).

As it has been mentioned, Pannonpower reacted to the challenge of ETS by changing the fuel of the power plant, then they built and are building biomass blocks. This allows Pannonpower to reduce the emission and to sell the available emission rights.

Focusing on Pannonpower the first investment into biomass block shows us market behaviour from the side of Power Plant. As the interviewee said 'they (Pannonpower) were the first to sell one part of quota decrease to the World Bank which they were lobbying for in Hungary. They have done it within the framework of Joint Implementation'. In reply to the question how a quota is given to a firm the interviewee expressed that above all great expert knowledge and high lobbying power are needed for this. All these matters are just about purchasing and selling. The purpose is profit maximization (*Pálné – Varjú eds.,* 2008).

As it can be seen, in this case the profit maximisation resulted in another action that generates new investment and technology transfer in EIS with direct linking to the new policy intervention.

The Norway case[9]

The case studies on emissions trading examine three enterprises subsumed under the Norwegian quota system. Following the coming into force of the Quota Act and the implementation of the quota system in 2005, these enterprises were among the 51 in all that became obliged to obtain and cancel quotas corresponding to their CO_2 emissions. The empirical study was conducted in 2007, but the analysis follows the three enterprises through the three year period in which the first quota system was in force. The quota system is to a large extent enacted in a bilateral relationship between the Norwegian Pollution Control Authority (SFT) and the individual enterprises. Key issues are the enterprises' reports on previous year's emissions, the decisions on quota allocation, the subsequent cancellation of the appropriate volume of quotas and the strategic responses chosen by the enterprises to adapt to the change in business conditions imposed by the new system.

Whereas some enterprises for a variety of reasons accumulate a surplus of quotas, others face a shortfall. For the latter group of enterprises, available options in the short run are mainly to buy quotas or to reduce or terminate production. In the longer run the enterprises may consider implementing changes in their production technology, including the use of quota exempt fuels. But such options depend on technological particularities, and are not equally available to all branches of industry. The three enterprises chosen for the study are quite different in terms of these conditions.

Trondheim Energy Remote Heating Company (TEV) has accumulated a surplus of quotas due to a shift in energy carrier made possible by the inherent flexibility of the remote heating system.

The cement producer Norcem has developed new technologies enabling the use of special waste in their ovens, thereby accumulating a surplus.

This option is not available to the third enterprise, chalk producer Verdalskalk, and this enterprise has experienced a shortfall in quotas. Verdalskalk is a producer of chalk located in the small town of Verdal (13,962 inhabitants), in Nord-Trřndelag county in central Norway. Verdalskalk is the number 12 largest CO_2 emitter of the 37 enterprises that received quotas in 2005-2007. However, the 146,763 quotas allocated to Verdalskalk in the period comprised only 0.76% of the total volume of quotas in the system. Verdalskalk produces chalk from minerals (limestone) extracted in the mines in nearby Tromsdalen, the largest and purest source of limestone in northern Europe. The chalk produced by Verdalskalk has a very high level of purity, and is used by the food industry among others.

Because the purpose of the production process is to release the CO_2 from the Calcium Carbonate, CO_2 is an unavoidable by-product. Verdalskalk's dilemma is that it is quite difficult to reduce both forms of emissions. Because the technology for CO_2 harvest is still in its infancy, the 28% released through the production process cannot be contained by currently available procedures. Verdalskalk chose to purchase quotas to cover the difference (*Hanssen et al.,* 2008).

In Norway we could detect another strategy which is the quota purchase. In this case there is a *pre-commercial* (or missing) *stage of technology development* (*Ockwell,* 2008, 4113) which impacts on the nature of technology transfer. In this sense, the missing new technology resulted in the use of old one going hand in hand with the use of "end of pipe" technology, which only can affect the conventional segment of EIS (environmental protection/emission reduction).

The Poland case[10]

The first AIJ project was initiated in Poland in 1996 in the cooperation with the Government of Norway. The experience gained at pilot studies helped in the later projects. The first of them could be implemented already before the official acceptance of the rules and procedures of Joint Implementations by the Parties of the Convention. This was a Polish-Dutch project of the use of biomass from city green areas for the needs of heating in Jelenia Góra (the project was completed in October 2000) (www.mos.gov.pl).

The project consisted of two parts: one concerning the use of methane from the landfill in Zoniówka and the utilization of methane obtained from the fermentation of the sediments in the sewage plant in Zakopane. The methane from the landfill and the sewage plant was supposed to be burnt in special gas motors and used for the production of the so-called "green energy". The energy produced was supposed to supply the waste sorting plant and used in the sewage plant. The possible surplus was planned to be sent to the energetic network and sold. The project addressed important questions related to public utility services in Zakopane. First of all, the investment in the landfill would help to comply with the legal requirements of the environmental protection concerning the necessity to degas all landfills. Second, the project was to solve the problem with the disposal of the sediment from the sewage plant. At present, the sediment is transported with barrel trucks to the landfill situated more than 100 km off Zakopane. This means high costs of transport and sediment storage.

During the implementation of the projects several problems appeared. The main barrier, however, was the procedure in the Ministry of the Environment. After passing these procedures the installation to win the gas was constructed and the torch, where the gas is burnt, was installed. However, in autumn 2006 there was a break in the production of methane. Experts responsible for this investment suspected that the reason was an insufficient humidity of the waste material (the landfill had previously been covered with a foil). An attempt to stimulate gas production was made by pouring the eluate from the landfill into gas wells, however, this did not yield expected results. Moreover, problems connected with the failure frequency of the measuring devices appeared. Accurate measurement of the quantity of the generated methane is a significant question due to the necessity to approve these results by an independent auditor.

Preparations for the implementation of the second part of the project regarding the sewage plant were also started. In 2006, after a technically difficult and long-term demolition of the containers of reinforced concrete, a site for building the sediment fermentation chamber was prepared. At the same time a tender was announced that aimed at choosing the contractor for constructing the installation generating the biogas. The tender was not decided due to a small number of offers (two) and too high prices proposed by the potential contractors. The projects needed then additional financing (*Lukomska, et al.,* 2008).

As it can be seen, in Poland, the (horizontal) technology transfer worked (generating the EIS in policy field, in different geographical location), but there were some problems with the capacity building, namely with the institutional settings.

Conclusion

Regarding the mechanism of the Kyoto Protocol, Joint Implementation can be a policy framework for policy intervention resulting in technology transfer, and the spread of the development of environmental industry sector; however, there can be several obstacles or influences in the realisations. As Frenken, K.–Izquerdo, L. (2009) state, if the number of actors in a society is small, all innovations are instantaneously adopted ("linear progress"). They also state that if the number of actors in a society is large, no innovation is adopted ("lock-in"). They conclude for intermediate number of agents, (1) the model generates sudden technological transitions even though innovations are always incremental; (2) shows that transitions are generally preceded by recombinant innovation; (3) shows alternating periods of variety and standardisation. Although the stated conceptions above need further validations, they suggest us that the EU-ETS does not directly and evidently generate the development of environmental industry sector through the adoption of new technology. It suggests that the actors (obligated firms in ETS) may choose other strategies than development (as some of the presented case shows us).

As it can be seen above, different strategies appeared in different countries in order to implement the EU-ETS or the JI having regarded the KP. Technological transfer in Hungary and Poland can generate the development of environmental industry sector (EIS). But the manifestation is not going on in the recipient countries but the developed ones, as regards the transfer of the technology. Having regarded Ockwell's concept here can be found only horizontal, not vertical low-carbon technological transfer. So first conclusion can be here, that regarding the technological transfer in the EU – in connection with the implementation of KP – is mainly horizontal technological transfer which affects the development of EIS in the hosting countries. It also says that until Hungary cannot be a hosting country and leader in R&D in low-carbon innovation, its industrial sector – focusing only on the sectors with direct link to the KP – cannot be developing.

On the other hand, on firm level, there is another factor which can influence the development of EIS. This is based on the behaviour of firms. As the cases show us, industries first aim is to remain efficient and profitable They suggest several times that not the technology but the profit maximisation is leading the decision, leaving the old technology untouched, influencing in negative way to the development of EIS.

Ockwell, D.G. et al. (2008) differentiate six factors that determine the technology transfer – which has direct influence on the development of EIS. These are the capacity building, the stage of technology development, levels of integration in the transfer process, supplier/recipient firm strategies, property rights and the need for domestic ad international intervention (*Ockwell, et al.,* 2008). However the above presented cases point that these factors do not have unambiguous impact on technology transfer and the development of EIS.

As it can be seen, domestic or international policy intervention (like the regulated EU-ETS and JI) is not enough to achieve successful technology transfer and EIS development. What is needed in addition is as follows:

- Capacity building with appropriate institutional settings/governance – knowledge is not enough
- Conscious supplier/recipient firm strategies, which do not only focus on profit maximisation but take the wide range social responsibility into account – in an offshore way relating the local society
- Domestic policy intervention – relating the local government – can have a crucial role influencing the local firm.

These factors can generate the development of technology transfer and the development of EIS relating the use of new policy intervention.

Notes

[1] E.g. Worldwatch Institute, UNDP.

[2] For instance when a member state sells quotas to another, it is compulsory that the seller expends the income to increase the energy efficiency or to subsidize the investments of renewable energy.

[3] More details regarding the EU member states: http://www.co2-info.com/EU_burden_sharing.html (cit. 07/18/2006) and Norway: http://odin.dep.no/md/english/news/news/022001-070218/dok-bn.html (cit. 07/18/2006).

[4] Ex verb. Ockwell, David: Technology transfer - what is it and why the controversary? A discursive approach to policy analyses. THEMES Summer School, University of Sussex, Brighton, 23/06/2009

[5] The Environmental Kuznec Curve: A Survey of Literature. Simone Borghesi European University Institute. 1999.

[6] Based on the paper of Fahrner, S. 2008. http://www.gfors.eu/fileadmin/download/national_reports/GFORS_CaseStudyReport_DUT.pdf

[7] Based on the case study by Pálné – Varjú eds., 2008 http://www.gfors.eu/fileadmin/download/national_reports/G-Fors_Hungarian_Cases_Final.pdf

[8] Concerning the interviews with Pannonpower Company.

[9] Based on the article by Hanssen, G.S. et al. 2008.

[10] Based on the report by Lukomska, J. et al. 2008.

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ENVIRONMENTAL INDUSTRY AS THE BACKGROUND OF THE IMPLEMENTATION OF CLIMATE STRATEGY

János Szlávik – László Valkó

Introduction

An important event of the history of environment protection in the 1980s was the birth of independent environmental market, i.e. this was the time when environment protection and environment management became embedded into the processes of the national and the world economy. This was the time when environment protection became an unquestionable factor of both future-oriented economic policy decisions and daily economic and business processes, and several business companies thought they found new chances on the environmental market.

The global climate change became a central issue of environmental and sustainability programmes in the 1990s (Rio 1992, Kyoto 1997). The ways of solution, like mitigation and adaptation techniques only slowly change the structure of the environmental market, the environmental industry, because the majority of the tools assisting the solution of the climate strategy are far from the traditional "end-of-pipe" techniques. A significant part of these is not listed among environmental industry activities. However, the cost-efficient implementation of the national and regional climate programmes depends on whether the techniques and the management methods for the handling of climate change are available.

This study is an analysis of the major tendencies of environmental industry/market in the last decades, with the objective to point out the possibilities of environmental industry to support sustainability, in relation with that the chances of successful climate strategies. The "green alternative" cannot only be a method for the successful implementation of sustainable development, with climate programmes in the first place; it can also have a positive impact on the management of the economic crisis. The development of environmental industry/market in the complex sense will lead the whole society towards the implementation of environmental and climate policy objectives, and can mean an economically viable way for the companies and the households. (*Our essay is built to a great extent on the university note called 'Environmental management',* *edited by Kósi, Kálmán and Valkó, László, published by Typotex, 2006. Budapest.)*

Concept, structure and analysis method of the environmental market

Usually in technical literature it is supposed that environmental (protection) industry, environmental (protection) sector and environmental (protection) market have the same content and they are used as synonyms. *For the exploration of the birth, development and versatile impacts of the sector, the concept and handling as "environmental market" offers broader possibilities.* This term is used hereinafter. The designation of the subject of our study in this sense is basically identical with the definition of "environmental industry (Eco-industry group)" published by the OECD/Eurostat in 1999 and used since then; this study made its survey in the fields of "Pollution Management" and "Natural Resources Management" (OECD-Eurostat, 1999). What we see the difference in is that while the "environmental market" used by the OECD/Eurostat serves mainly statistical purposes and has a static approach, the "environmental market" offers much more possibilities for the analysis of the relations and the dynamism of the area.

In the broadest sense, the *concept of environmental market means the technical-technological and economic-intellectual tools of environmental management, and the actions of these*. As regards its structure, environmental market consists of investment goods, consumption commodities and services.

If we consider environmental market as an independent sector, we put those businesses and activities into this category that are engaged with at least one of the following functions:

- elimination of environment polluting emissions, and the manufacture of tools for this;
- protection against harmful immission, and the tools of this protection;
- production of consumption goods with more limited environmental impact;
- contribution to the increase of the assimilation capacity of the natural systems;
- measurement and analysis of emission and immission, and tools of this measurement;
- collection, transport and management of wastes;
- rational management of the natural resources by recycling or further processing;
- environment related services (consulting, commercial and marketing services, research and development, training and vocational training etc.).

In our opinion the *supply-oriented analysis* of environmental market gives us much more in-depth knowledge on this sector, its importance in itself and in the national economy, and we can better focus with this method on the effects of environmental market like innovation effect, labour market effect and the sectoral and regional effects. The general economist approach of the market, however, requires the treatment of the *demand factors* that better approach the actual data of turnover as well, because supply cannot be fully identified with the concept "effective" (*Zimmermann,* 1981).

Among the structural elements of the environmental market, it is mainly the "environmental techniques" whose definition and designation is a problem, so the assessment of the market volume is still rather uncertain today, or is blocked by problems of economic statistics. The reasons for this are as follows:

- Environmental market is intersectoral and has "quasi" independence. The suppliers pf environmental industry goods belong to different sectors, it is especially chemical industry, mechanical engineering, electrotechnical industry, fine mechanics and optics, iron-, aluminium and metal industry, and construction industry that belong here.
- Many products used in environment protection are also used in other fields, such as pumps, control units, catalysts, filters etc.
- The concept of environment protection is different for the representatives of different professions. For example, energy-saving measures or the use of regenerative energies can be seen as environment protection, as environmental technique, but also as a measure modernising the whole of the economic process.
- It is difficult to separate the clearly environment protection part of an investment (or a new product), especially in the case of integrated environmental techniques.

Dynamising factors of the environmental market

The data on the macro-regional (e.g. EU) and national volume of the environmental market make its clear that the extent of this market and its industrial and services background are primarily determined by the factors described in the following paragraphs (the individual factors are of course closely related to each other and it is only methodical aspects that made us treat them separately). In the paragraphs below we briefly comprehend the *environmental market effects* mentioned above:

1. *Direct state participation* from the beginning (environmental budgetary expenditure and their impacts) are the most significant demand factor on the environmental market. Although consistent and effective environment protection

forces/encourages businesses, institutions and the inhabitants to pay more and more, nevertheless the “state guaranteed market” of the environmental market, emphasised many times, is still a dominant character.

The 1st National Environmental Programme, NEP (1997–2002), comprehended as the Hungarian Agenda 21 programme, assumed that a 62% proportion from the financing of the tasks mentioned in the documents came from central resources (state budget, funds) and other sources only financed 38% (businesses, municipalities, inhabitants). In accordance with the international tendencies mentioned in the previous chapter – i.e. that the role of the private sector is increasing in the financing of environmental investments –, the costs of the sectoral action programmes in the 2nd NEP (2003–2008) show a much more “balanced” breakdown, inasmuch as the central resources are a guarantee for only 50% of the programme.

A considerable and also market-conform factor showing the devotion of the state to environment protection and promoting the intensification of the environmental market is the *public procurement process, public consumption*. The best way to demonstrate its significance is to mention that the total value of the public procurements of the public sector (ministries, municipal organisations, public institutions etc.) in some member states makes 13–17% of the national GDP, which means an amount of approximately € 1,500 billion annually spent on goods and services. For a comparison: the share of private consumption is approximately 50–60% (OECD-Eurostat, 1999),

The 6th Environmental Action Programme of the European Union (2001–2010) decided, in order to strengthen the environmental responsibility of the public sector and promote the environmental activity of the private sector, to supervise the public procurement processes of the public institutions and the assistance of the eco-conscious public procurements. The new community guidelines on public procurement (2004/17/EG and 2004/18/EG) allow a wider and more regulated space for the consideration of the environmental aspects in the public procurement processes. The Commission made a handbook (Green public procurement – public procurement with environmental view!), which outlines how – on the basis of the policy and strategy of the European Union aiming at sustainable development – the organisations publishing the calls for tenders can assert the environmental aspects in their public procurement processes. The handbook, by the introduction of examples, puts the main emphasis on the practical applications and not on legal approaches.

In Hungary, the Ministry of Justice suggested, in its draft for the amendment of the Act No. CXXIX. of 2003 on public procurements, that Hungary should use the possibility offered by the EU guidelines and the Ministry should start negotiations with the environmental authorities to promote the adaptation of the practice of green public procurements in Hungary.

2. At both national and international level, the *legal and economic regulation of the environmental issues* in a single framework, with adequate emphasis on and a *consistent* use of requirements and guarantees, is a prerequisite for the independent environmental market and its integration into an industry sector. All areas of environment protection have been under the control of strict legal regulation since the beginning. Despite the fact that there are still regional differences across the intensity of the legal regulation, the growing strictness of regulation can be seen as a permanent tendency. Regulation also determines the structural dynamism of the market: the changes in the demand for environmental products and services, the birth of special demands, special needs and the supply satisfying these are all functions of the regulation. The environmental requirements, threshold values can determine the development of certain environmental fields for a long time.

More rigorous environmental regulations induce a livelier activity on the environmental market. Consistent public environmental policy is always built on a *healthy combination of legal regulation and the supporting financial assistance*. Without such state "injections", the environmental consciousness of the companies would be rather weak.

In the present international practice of environmental regulation there are three – closely related – tendencies: (1) The penetration of the economic regulation tools promoting more environmental conscious behaviour and strengthening interests, instead of the direct prohibiting regulations. Since the signing of the Kyoto protocol and even more so the accession of Hungary to the European Union, environmental consciousness is practically the same as climate consciousness. (2) A sort of compensation of the eco-taxes. (3) The "ecological" transformation of the taxation system.

The joint effect and impact of these three tendencies can be best seen in the *ecological tax reform* known from the German practice, as a result of which the consistent environmental regulation of the state *"forces and encourages"* a wide range of businesses to follow a more environment conscious behaviour and consumption patterns, and implement environmental investments and developments. The reform was launched in 1999 – with the direct objective to rationalise energy use –, and by now the positive economic and environmental impacts have become obvious (for a detailed analysis of this see *Wirkungen der Ökologischen…* 2005).

As a *compensation* part of the ecological tax reform, a significant proportion (approximately 90%) of the tax revenues are returned to the taxpayers, as the major part of the revenues was used for the decrease of the pension contributions paid by the employers and employees in several steps (irrespective of the ecological taxes, the pension contribution taxes show a growing tendency, due to demographic processes). Hundreds of millions of euros are spent every year on the promotion of the use of renewable energies (e.g. in 1999 DM 200 million, in 2003 € 130 million, in 2006 € 230 million). One billion euros from the revenues of the energy taxes are spent on the promotion of the better energy efficiency of the private homes and public buildings.

3. In addition to the legal regulation and the direct environmental expenditure of the state, international experiences show that the *activity of the bank sector* can have an active role in the initiation of the growth of the environmental sector. The banks have financial tools from state budget, their own resources and other channels (programmes, funds, foundations) for the support of environmental investments. Their common feature is the possibility of preferential use: preferential credits, more favourable duration for the client, special incentives. Several banks of the world sponsor environmental programmes with public relations purposes (eco-sponsoring by the banks).

Another sign of the environmental activity of the bank sector is when the leading financial institutions cooperate with interested industrial companies in the development and operation of *environment protection, climate friendly solutions of reference character* and jointly enter market with these (e.g. environmental technology developments, reference auditing etc.).

4. Besides the channels provided by the bi- and multilateral international cooperations, we have to emphasise the environmental industry developing and the environmental market expanding impact of the *international environmental agreements* aiming at the solution of concrete problems at macro-regional level. (The international agreements primarily increase the production and market intensity of the investment and service type environmental goods.)

The environmental market promoting effect of the international environmental agreements and protocols can be demonstrated in the case of practically all agreements in effect. We have to select from these, however, the market effects initiated by the international trade of emissions opened by the entering into force of the Kyoto Protocol (1997) in February 2005. On the one hand, this has an international impact; on the other hand its impact will probably be a long-term one; also, a broad range of economic institutions (including industrial companies, consulting firms, the financial sector, stock exchange etc.) is supposed to be involved. The dynamism of the environmental market is also actively promoted by the Integrated Pollution Prevention and Control (IPPC) directive of the European Union, which primarily promotes the market of the environmental technologies and the environmental services, including research and development.

5. The *development of the environment consciousness of a society* is an important factor in the enlargement and structural development of the environmental market. A special manifestation of the environmental activity and ecological consciousness of the inhabitants is the shift in the consumer behaviour, which is more and more visible in the growing demand for so-called eco-products. This impact concerns the market of consumption goods in the first place, mostly not the volume but the structure of that. The efficiency of the business and institutional environmental management is a dominant factor determining the environmental market needs of the companies.

Hungary joined the European Union on 1 May 2004. Now we can have some ideas concerning how the *accession of Hungary to the Union* impacts and will impact in the future the sector of environmental management. It is known that the European Union had already supported the accession countries in several fields before 2004; one of the resources for this purpose was the so-called ISPA pre-accession fund (Instrument for Structural Policies for Pre-Accession), by which the lagging of the environmental and transport sector could be decreased. The EU statistics reveal that the most dynamically growing areas of the "climate effect" are road and air transport.

It is worth looking at the impact of the *ISPA and Cohesion Fund supported investments* on the Hungarian environmental sector, to let us see what happens during an ISPA/Cohesion Fund investment, what effects they have on the Hungarian environmental sector and the competitiveness of the Hungarian economy. During the use of the resources it is actually a complex environmental investment that is implemented, with non-refundable EU support, intensive state participation and (usually 10%) self-financing by the municipalities. The support sums awarded in Brussels are manifested in contracts and in the money reimbursed in return for works done (*Table 1*).

Table 1.

*Cornerstones of the ISPA and Cohesion Funds support for environmental purposes in Hungary, in billion HUF**

	2000	2001	2002	2003	2004	2005	Total
Awarded	32.08	24.18	38.14	45.11	136.87	0	276.38
Contracted	0	0.05	1.17	22.94	29.39	8.47	62.02
Paid	0	0.02	0.57	3.77	10.16	3.89	18.41

*Calculated with 250 HUF/EUR exchange rate.
Source: Kiss, 2006.

Knowing these data it is not an exaggeration to say that the Cohesion (and Structural) Fund supports are the Marshall Aid of the 21st century for the Central-East European member states. According to preliminary calculations, in the 2007–2013 period Hungary will receive many times more support than it received before, also for the field of the environment, so we can assume that the almost 1,200 billion Forints available for Hungary in the coming seven years will be a *dominant factor in the future* in the economy of Hungary, including its *environmental sector.*

Environmental sector and employment

The integration of the environmental industry and service sector into the whole of the economy can give new impulses (which were called formerly the "by-products" of the environmental market) to the handling of urgent social problems like e.g. unemployment, without the use of direct social policy tools. The debates on the impact of environment protection measures on the labour market have been old; they actually started in the mid-1970s, when environmental policy became an independent field. Since that time the possible negative impacts of environment protection on employment, and also the positive consequences have been a recurring issue. During the consistently worked out and implemented environmental programmes, both impacts have to be taken into consideration, the issue that really matters is the balance of the impacts of opposite directions. All of the studies written abroad on this topic emphasise the much above average *"labour intensive"* character of the environmental (industry and services) activities, and also their high *"innovation carrying"* capacity.

For example, in the different – regional and national level – environmental policies and the climate strategies of the EU the role played in the easement of the employment problems is seen as the "positive by-products" of significant impact of the strict environmental measures. Also, environment protection is among the first sectors on the list of possible job creating sectors when it comes to planning employment policy. The Community defined the first independent programme for the enhancement of the role of environment protection in labour market in the framework of its 5th Environmental Action Programme (1993–2000). When evaluating the relationship of job creation and environment protection we cannot neglect the fact that, as mainly German and Austrian examples show, the costs of the job creation programmes realised through environmental developments do not exceed the costs of the other programmes with the same intention in other fields.

The engineering and application of the environmental investments goods and consumption commodities, and the penetration of the environment-centred management techniques and methods are considered in Germany as a considerable economic factor (*Table 2*). As soon as in the middle of the 1990s an important correlation between the exports rate of environmental technology products and employment was published: *one per cent growth in the export of the environmental products results in the creation of 1,500–2,000 new jobs* (*Umweltschutz,* 4/1997).

In Germany in 2002 almost a million and a half employees, i.e. approximately 3.8% of the total labour force was employed in environment protection (*Table 3.*). This figure is higher than the number of labour force working in car industry, mechanical engineering or even food industry. The growth from 1998 to 2002 was mainly due to the intensive utilisation of renewable sources of energy (mainly wind energy and biomass). A slight decline in the environmental employment was caused by the more moderate investment activity in the traditional environmental fields (air quality protection, sewage treatment, waste management). On the other hand, the number of those working in the production of export goods doubled. A massive area of the environmental labour market is the services sector that covers a wide range of activities (from the provision of classical engineering and consultancy tasks to the several commercial, training, banking, and administrative etc. activities).

Table 2.

Growth of environmental jobs in Germany, 1998–2002

Field of employment	Number of employees		
	1998	2002	Difference
Alternative energies	66,600	118,700	52,100
- investment and operation	56,600	105,700	49,100
- services	10,000	13,000,	3,000
Environmental investments	153,400	118,000	-35,400
Maintenance of environmental establishments	187,500	181,000	-6,500
Export of environmental products	22,000	47,000	25,000
Environment-oriented services	929,500	963,000	33,500
Thermal insulation of buildings	53,400	45,400,	-8,000
Total	1,412,400	1,473,100	60,700

Source: Umwelt und Beschaeftigung. Bundesministerium für Umwelt. Berlin, Januar 2005.

The above examples also highlight an important correlation: this is the *duration of the environment-related jobs*. Another important aspect – considering the large number of the long-term unemployed – is that *environment protection as an employment sector offers a better possibility to enter the primary labour market from the secondary one*.

The worsening of the environmental conditions and the high level of unemployment are the two most depressing problems of the present Europe. A growing number of governmental or Community level documents and concrete programmes are published whose objective is the joint handling of the two problems (either of them is complex in itself anyway). Integrated environmental and employment strategies enjoy priority in the European Union.

The European Environmental Press (EEP) published the information leaflet – contracted and financed by the EU Commission – that is meant to demonstrate the political will for the handling of the problems, on the one hand, and introduces successful practical initiatives and results, on the other hand. At the same time, this leaflet does not hide the negative impact of environmental burden of the company employment policy, either *(Beschäftigung im europäischen Umweltbereich,* 2000).

For the time being environment protection gives work to approximately 3.5 million people in the EU. Already in the mid-1970s a clear classification process of the environmental sector could be seen: (1) Traditional environmental fields are those professions where a traditional working area is given a stronger environmental emphasis (e.g. water management or waste management). (2) Activities generated by the topical social and environmental policy (control of harmful emissions, development of bio-farming etc.). (3) Professions organised on the tasks induced by the market demand (consultancy, customer information services etc.). Among the employees of the environmental sector, approximately 2 million people work in the provision of environment friendly technologies and renewable energies, and in the field of waste recycling and nature protection. The remaining – approximately 1.5 million – jobs can be found in environmental industry itself in the narrower sense.

Of course environmental sector cannot be categorised into any economic sector, it follows the heterogeneity of the industries. According to the observations of the EU, presently there are five independent economic sectors where the employment effect of environment protection is the most significant: processing industry, transportation, agriculture and energy sector – and recently construction industry, in close correlation with the climate programmes. According to the estimation of the German Economic Research Institute (DIW), the programme aiming at the better thermal insulation of the homes in itself would create some 50,000–70,000 new jobs in Germany, similarly to the energetics sector, in both cases primarily in the category of medium sized businesses.

On the conditions and prospects of the *Hungarian environmental market* and *its employment effects* only an incomplete overview can be given, mostly on the basis of estimations, as we lack necessary basic data. Among other things the attempt made for the estimation of the demand of the businesses for environmental experts is published in the study of the Information and Training Institute of the Institute of Environmental Management (*Survey of the harmony of the qualification requirements and the training structure,* 1998). On the basis of the available information the experts of the IEM came to the conclusion that in 1997 there were approximately 2,500 companies in Hungary that had a significant impact on the environment, and these companies employed at least 4,000 independent environmental experts. The estimated number of those working in environmental industry and service businesses was 1,500. The total employment of environmental experts in the Hungarian business sector was approximately 5,500 people at the end of the 1990s.

According to the latest available data on the number of employment in the narrower environmental industry, in 2003 in Hungary there were 15,763 people working in the environment protection issues of the industrial companies, and this number may reach 40,000 to 50,000 by 2010. As regards the sectoral breakdown, the highest number of them was active in the services sector, followed by energy and water supply and manufacturing industry.

To demonstrate the direction of the researches in this topic we would like to mention the analysis that tries to assess the *employment impacts of the policy leading to sustainability,* in a wider sense than the analyses with environmental view, until 2020 for Germany, Switzerland and Austria, three countries different among other things in their natural resources endowments. The central element of sustainable development – as the survey assumes – is the raw material and energy saving economy. Having this concept in mind, the researchers tried to find out what is the employment potential of an environmental and economic policy that, built upon the presently known and economically produced and operated energy-saving products, technologies and production methods, would implement a 30% decrease of the use of non-renewable energies (coal, oil, natural gas) and a 25% decrease in the use of raw materials until 2020 compared to the amounts used in 1990. The experts were of the opinion that considering the present trends and tendencies, the realisation of the above objectives is possibly feasible in Germany and definitely realistic in Austria and Switzerland.

As an important methodological starting point of the analysis, 66 products, technologies and production methods were included in the survey: those whose environmental conformity is well-known, whose application is not blocked by economical consideration of the scarcity of resources, such as: ecological land use; recycling of metals, vehicles, electronic devices; gas-, steam- and wind power stations; solar energy powered devices; natural gas driven tools; biologically degradable plastics; energy-efficient buildings etc. (*J. Scheelhaase,* 2000). The development trends briefly described above have direct and indirect employment impacts in the respective industry and service sectors, in the breakdown indicated in Table 3.

The most important generalisable – and for the Hungarian economic and environment development strategy utilisable – message is that an *environment conscious economy which plays a decisive role in sustainable development* has the following features**:**

1. it has a positive net employment impact;
2. it has a rationalising character for the whole of the economy;
3. its technological foundations are already existing both from technical and economical aspects;
4. political determination and will plays an important role in their implementation.

Table 3.

Assumed employment impacts of a sustainability policy by sectors

Direct employment impacts	Indirect employment impacts
Metal industry, chemical industry, petroleum processing, automotive industry, mechanical engineering, electrotechnical industry, glass industry, paper industry, transportation, agriculture, mining, construction industry, electricity industry etc.	Food and excise goods industry, textile and leather industry, wood processing industry, trade, catering industry, bank and insurance services etc.

Source: Scheelhaase, 2000.

In the effective solution of environment protection tasks, the development of up-to-date environmental technologies and the application of the state-of-the-art environmental management methods, and the employees with environmental qualifications play a key role. Table 4 shows the estimated number and the sectoral breakdown of those who received environmental qualifications in the Hungarian higher education from the start of the trainings until 2006. The survey contains data received from the institutions for a research conducted at the Department of Environmental Management of the Technical University of Budapest.

Table 4.

The number of environmental management graduates until 2001 and the forecasted number of graduates in higher education – aggregate data, 1996–2006

Major	Number of graduates (1996–2001)	1996–2001	2002–2006	1996–2006
Environmental engineer	full-time	1,239	1,877	3,116
	other	1,400	900	2,300
	specialisation	604	805	1,409
	Total	3,243	3,582	6,825
Environmental management agro-engineer	full-time	721	1,100	1,821
	other	450	500	950
	specialisation	353	460	813
	Total	1,524	2,060	3,584
Teacher of the environment	full-time	70	362	432
Teacher of environment protection	full-time	294	325	619
Environmental science	full-time		197	197
Environmental pedagogy	full-time	364	884	1,248
	other	500	350	850
	Total	864	1,234	2,098
Total:	full-time	2,324	3,861	6,185
	other	2,350	1,750	4,100
	specialisation	957	1,275	2,232
	Total	5,631	6,886	12,517

Note: 1996–2001 number of gradates finishing higher education in 1996–2001; on the basis of the forecasted number of graduates in 2002–2006.

Compiled by Dr. Valkó, László (Technical University of Budapest, 2003) from own researches.

Environment protection and technical development

Environment protection and environmental techniques

Under the term *"environmental technique"* we mean those technical procedures, equipment and the related activities that serve the purpose of environment protection. Environment protection can be comprehended (examined) in the following ways:

1. *By fields of activity* (environmental media): e.g. climate protection and air cleanliness protection, water protection and sewage treatment, nature and landscape protection, protection against noise etc.

2. *Functionally*, when environment protection means the elimination, regeneration (compensation), decrease, prevention or monitoring (analysis) of the harmful effects of the human interventions into the environment.

Following the above analysis, we can differentiate among 4 main fields of environment protection activities, to which the adequate environmental techniques can also be ordered:

– ex-post environment protection,
– regenerating (compensating) environment protection,
– preventive environment protection,
– surveillance and analysis of the environment; plus
– environmental services.

During *ex-post environment protection* we use those techniques that are suitable for the elimination or decrease of the environmental burdens that have already occurred, resulting from production and consumption. These can be: the so-called liquidation techniques (techniques for the neutralisation of old pollutions), waste management techniques, sewage treatment techniques and "secondary" recycling techniques etc.

Although *compensating environment protection techniques* are also ex-post, these are not used for the elimination, decrease or transformation of residual materials; by applying them we try to enhance the carrying capacity of the environmental elements and ecosystems – in the general sense –, and also to decrease the existing environmental burdens, without eliminating the environment pollution itself. Such a method is the liming of the forests and soils, the aeration of waters, the application of biotechnology procedures promoting the adaptation of the wildlife (flora and fauna) to the changed environmental conditions (e.g. climate change) and the architectural procedures of protection against erosion, deflation, noise etc.

Preventive environment protection techniques are those techniques that are suitable for the decrease of the emissions from production process and consumption, on the location of the emissions. This includes – although it is still very often referred to as ex-post environment protection technique – the ex-post in-built or additive environmental technologies ("end of pipe") that usually means special technique or procedure connected to certain phases of the production process (e.g. smoke gas cleaning equipment, car catalysts etc.). Also, those technical procedures belong here that are applied at potential environmental stresses, for saving raw materials and energy, or the substitution of materials especially dangerous for the environment.

The group of *environmental surveillance procedures* involves those techniques that are used for the measurement of emissions and the supervision of the environmental quality (*environmental monitoring*).

If we wish to refer to the role of environmental techniques in the whole of the economy, we cannot neglect the field of *environmental services*, either. Environmental services are often end users or bases for the ecologically and economically optimal use of the environmental techniques: e.g. environmental consultancy, carrying out of environmental impact analyses and other environmental analyses required by law, implementation of eco-audit, compilation of environmental (eco) balance sheets, environmental training and education etc.

Comparison of the additive and the integrated environmental techniques

The ultimate objective of all environmental policies is the substitution of ex-post and compensation environment protection, i.e. the focus on the preventive environment protection. For the realisation of preventive environment protection, both additive and integrated environmental techniques are suitable (for details see *R. Coenen et al.,* 1996).

Additive environmental technique – as opposed to integrated environmental technique – is relatively well definable. Its procedures can be easily described from technological aspect. This group involves those tools and equipments that are "built into" the production processes or the products, by which the flow of the residual materials from production and consumption decreases or they get to the environment in forms that are less harmful for the environment and more easily controllable. Typical additive technologies are filters, smoke gas cleaning procedures, catalysts etc.

A fundamental expectation towards *integrated environmental technique* is to remedy this disadvantage of the additive environmental techniques, i.e. they should automatically secure the minimum burden of the environment in the different phases of the production process by preventive methods. Integrated environment protection *harmonised with production* involves all those procedures the objective of which is the avoidance of the unfavourable environmental impacts of the production-manufacturing process. In this approach the manufacturing process itself is an environment protection process. The goal of integrated environment protection *related to the products* is that the factors important for the environment and dependant on the products should be considered as soon as during the design, development and manufacturing (eco-design). Environmental characteristics and criteria by which integrated environment protection (both production process-oriented and product-related) can de depicted, as opposed to the traditional technical procedures and products, are as follows:

- A shift to production procedures requiring less energy and material resources (resource orientation).
- A thriftier energy management using waste heat.
- Recycling within the production process, and the improvement of the control of the circulation of materials (primary recycling).
- Decrease of the quantity of the unavoidable residual materials.
- Substitution of additives harmful for the environment.
- A complete substitution of products and production procedures with their less environment polluting alternatives.
- Strengthening of the environmental conform features of products (longer duration, repairability, treatment less polluting the environment).
- Enhancement of recycling, and the less environment polluting treatment of the unavoidable residual materials.

The additive and integrated environmental techniques as concepts of similar content can be seen as a paradigm shift in the field of environmental engineering. The additive and integrated environmental techniques, however, are not alternatives for each other. The ecological optimisation of the production processes and the products is often only possible by the parallel use of both techniques. For example, during energy production from fossil fuels we cannot abandon additive environmental techniques even if the process of energy production would be more eco-optimal than in the other case. The so often mentioned 3 litre cars (i.e. cars using 3 litres of fuel per one hundred kilometres) must also be equipped with exhaust decreasing device. Especially in cases of direct danger to the environment and health, additive technical solutions are often irreplaceable.

Economic effects and efficiency

In the paragraphs below we attempt to compare the advantages and disadvantages of the integrated environmental techniques. During this comparison we take economic efficiency and ecological efficiency into consideration. Our statements are valid for general characteristics and are only used for the demonstration of tendencies (*Table 5*).

The use of additive environmental techniques, as we have already mentioned, always mean the integration of an ex-post equipment or tool into the production process, resulting in the increase of the production costs. In other words, this *does not bring about any significant change in the production process, its application is limited to the environmental measures, only*. Because the application of additive environmental equipments usually does not result in the considerable increase in the incomes, revenues, they definitely lead to the decrease of productivity, and in some cases of competitiveness.

Table 5.

An economic comparison of the additive and the integrated environmental techniques

	Additive environmental techniques	Integrated environmental techniques
Total productivity	decreases	possibility for increase
Production costs	rise	possibility for decrease
Investment demand	lower	higher
Depreciation of production equipments	usually no	possible
Information and access costs	lower	higher
Costs of adaptation and transition	lower	higher
Business compatibility	higher	lower
Economic risk	lower	higher
International market position (in environmental technology)	presently very good	possibly very good
International competitiveness (of the total economy)	decreasing tendency	possibility for future competitive advantages

Source: Coenen, 1996.

The application of integrated environmental techniques offers a possibility for the avoidance of the supplementary costs and for the decrease of the production costs. An example for this is if the decrease of the environmental burden also means the more efficient use of the resources (raw materials and energy), or if recycling saves us from a part of the expenses of waste neutralisation. In addition, the change of the production processes or the product structures – if integrated environmental technique is a concomitant of the general innovation activity – can lead to the increase of the total efficiency or the labour productivity. The use of integrated environmental techniques will more or less change the whole of the production process as well, which may reach the complete change of the production tools or the product range.

Economic risk is usually higher at the integrated environmental techniques, as the additive techniques are usually more commercialised and tried, while in the case of integrated procedures we lack any operational experience and thus the actual operational costs are more difficult to estimate in advance. As integrated techniques are the most closely linked to the whole of the production process (they are equal to those, actually!), the risk in case of their malfunctions and closedowns is also higher, which may jeopardise the very existence of smaller businesses. For the tackling of this problem and for the increase of the receptiveness of the companies for integrated environmental techniques, in several countries there are governmental programmes of reference character for the development of environmental techniques and the financial assistance for smaller companies to buy such techniques (especially in Austria this way of support is quite frequent).

Ecological impacts and efficiency

Integrated environmental techniques are important mostly from the aspect of energy and material efficiency, because they are suitable for the treatment, i.e. the decrease of the quantity of the sources of environmental burdens, the use of energy and raw materials. To the opposite, the *additive* or ex-post environmental techniques usually require further, supplementary energy and material inputs (see Table 6). Integrated environmental techniques have broad damage elimination potential, i.e. they are suitable for the neutralisation of several materials and environmental elements at the same time. To the opposite, additive techniques usually only guarantee the decrease of one single emission.

As we have seen several times, additive techniques are usually built onto the available production and consumption processes. Their essential feature is that they transmit the strikingly bad pollution emissions to another material or environmental medium, which is easier to control and offers better neutralisation possibilities. Additive environment protection thus very often leads to the postponing of an environmental problem and not to the final solution of the respective problem. In the case of integrated environmental techniques – because of the direct transition of the production process – this postponence effect is weaker, but is not excluded. For the handling of some pressing environmental problems there are no additive techniques or only partial solutions available. Such an issue is for example the management of the emission of greenhouse gases (CO_2, methane, CFC-s). In this case it is only the use of solutions built on integrated environmental techniques that is possible, e.g. by the increase of energy efficiency.

The advantages of the integrated solutions of environmental techniques are seemingly unquestionable compared to the additive methods. Nevertheless their application in the investment and innovation process of the companies has been rather exceptional so far, although the tendency is a clear increase.

Table 6.

An ecological comparison of the additive and the integrated environmental techniques

	Additive environmental techniques	Integrated environmental techniques
Energy and raw material efficiency	lower	higher
Range of application	for specific hazardous materials	for a wide range of hazardous materials
Possibility for the extension of the problems in time and across the elements	high	low but not excluded
Possibility for the treatment of the environmental problems	not for all environmental problems	for a wide range of environmental problems
"Compensation" of the neutralising effects	possible	possible

Source: Coenen, 1996.

In the implementation of sustainable development a key role is played by technical progress, an important field of which is the innovation activity of the companies and the environmental character of this activity. Requirements in harmony with the principle of sustainable development, such as long-term guarantee of the natural resources and the environmental quality, also necessitate the fundamental transformation of the present production methods and consumption patterns. We have to make a theoretical differentiation between the *"adequate strategies"* and the so-called *"efficient strategies"*. The former sees the realisation of the desired objective in the simple change of the lifestyle and the production procedures, as opposed to the efficient strategies that emphasise the necessity of a comprehensive technical change. This latter strategy sees the promotion of environmental innovations as a basic element.

From an economic point of view, the return of the technical development is the introduction of a new or several up-to-date products on the market, or the application of a new production procedure. Product and process innovations are more and more often recognised aspects of the long-term stability of the market-oriented business management, still the major technical investment of these days often lead to increased environmental interventions and the growing demand for natural resources. This is one of the reasons why the environment conform direction of the technical and technological development is given a key role in the concepts and debates on sustainable development.

Practical observations show that *environment protection* has gained a better and better position among the objectives of the technical development processes of the businesses, but it *has not become a decisive factor in modernisation yet.* Environment protection thus – be it additive or integrated – cannot be seen as single innovation feature; it is only a partial element in the general modernisation and it appears together with other innovation purposes. During the implementation of business innovations it is exceptional that the production processes are built on completely new grounds. If still this is the case, the chances of integrated environmental techniques are improved. However, the majority of company developments are not more than the modernisation of a part, of one component of the product or the production process. There are many reasons why companies are afraid of the change of the complete line of the technology. They are only willing to make this step if the advantages of the competing new technology line is absolutely evident. This is usually true for the environment oriented technical developments.

As integrated environmental techniques – coming from the definition – are organic parts of the new production methods and the products, they have to be taken into consideration as soon as in the first development phase of the environment oriented innovation processes, as opposed to the additive environmental techniques where the so-called *"innovation window"* opens up later. Preventive innovations – like integrated environment protection, or the improvement of the working conditions in general – have a clearly higher relative advantage in the beginning of the innovation process than in the later phases. The period of preparation for the integrated environmental techniques is longer and their R & D demand also takes more time than in the case of additive techniques – observations suggest that the difference is approximately 6 to 10 years. The increase of their competitiveness has two major prerequisites.

One is the *more intensive support then presently for the R & D phase of the integrated environmental techniques or organisational innovations (introduction and certification of environment management systems)*, for example the increased state support for industrial environmental innovations by the financing of selected programmes. Only such programmes can secure the interdisciplinary background coming from the nature of the researches, and can also contribute to the improvement of the receptiveness of the businesses for environmental innovations. In Austria e.g. it has become a practice to "test" the EU level environmental directives before their application in the country, with state promoted and supported reference projects; this way the potential bottlenecks can be identified and the reservations of the businesses and institutions solved. In Hungary the ministry of the economy also promotes through its tender system the participation of – mostly small and medium-sized – enterprises in the application of the ISO standards supporting the quality insurance and environment management systems, also promoting thereby the adaptation of these businesses to the EU market requirements.

The other precondition is to *make sure that the already existing environmental technique solutions and up-to-date management techniques and procedures are available for the businesses through the adequate information and consultancy channels*, decreasing the transaction costs. These objectives are implemented in the practice of the EU by the environmental technology databases, or maybe the works aiming at the compilation of the reference lists and the application of the BAT (Best Available Techniques) supporting the implementation at Community level of the IPPC (Integrated pollution prevention and control) directive. The basis task of the EU IPPC office operating in Seville is to collect and process at sectoral level the descriptions of the cutting edge environmental technologies and procedures, and guarantee their flow to the member states by the cooperation of the national offices. The full application of the directive (i.e. the application of the requirements of the directive at the level of the already working establishments) started on 30 October 2007.

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THE DEVELOPMENT OF THE ENVIRONMENTAL INDUSTRY BY THE UTILISATION OF THE ENERGETICS POTENTIAL

Antal Penninger

Introduction

Hungary has unique natural endowments, both as regards the average quality of the arable lands and the size of arable land per capita. In addition to the agricultural yields, the good geographical endowments, animal husbandry, and the balanced character of sylviculture, the number of sunny hours is high on the average, and some regions possess a considerable wind energy and geothermal energy potential. This potential raises the possibility and the necessity of the more efficient utilisation of the renewable energies in the future development of the Hungarian energy supply, with regard to a CO_2 emission that decreases climate change, the decrease of the dependence on fossil energy sources, the energy production of the agriculture impacting the whole of the environmental industry, and the possibility of job creation in connection with the manufacturing, operation and maintenance of the related energetics devices. All this requires the making of energy balances for the whole of the country, broken down to micro-regions.

The present situation must be assessed, namely the amount of electric energy used, and the volume of different sources of energy (natural gas, electricity) used for heating and hot water production. These figures must be compared with the local potential consisting of the various renewable energies that could fully or partially substitute both fossil fuels and the electricity transmitted through the cable network. This of course requires the ability and willingness of the micro-regional actors to associate on the basis of common interests, on the one hand, and the recognition of the fact by the government, on the other hand, that the population keeping capacity of the rural areas is a national interest. In the broader sense, the legal guarantee of the principle of subsidiarity can create, through the stability of long-term planning, the community bases of the liveable micro-regions.

The trust in food production must be regained, for which in Hungary the endowments are good by the cooperation of the agricultural sector and energetics (we will discuss it in details later). We can see that the trust of the people in different food industry products has decreased a lot, a good example for which is the recent penetration of the traditional way of making bread, despite the somewhat higher price.

The way micro-regional policy has been pursued for the catching up of the economy of Hungary is no longer feasible. The supports of the European Union for the utilisation of renewable energies, for example, mean in most cases that the machinery, equipment and technology necessary for the implementation are purchased abroad, creating jobs and tax revenues outside and not within Hungary. This practice must be eliminated very soon and those Hungarian small and medium-sized enterprises should be assisted with adequate R & D & I (research, development and innovation) which are able to raise the quality of their products to the level of the foreign products and thereby can become competitive in the European area.

Of course, the symbiosis of the environmental industry and energetics, in addition to the already mentioned impacts, could strengthen the conditions of local infrastructure (road network, railway, post office, school, hospital etc.), and through the improvement of the chances of life in the countryside and the belief in the future, could lead to a more a liveable Hungary, and to more effective environment and landscape protection.

The bases of micro-regional energy policy

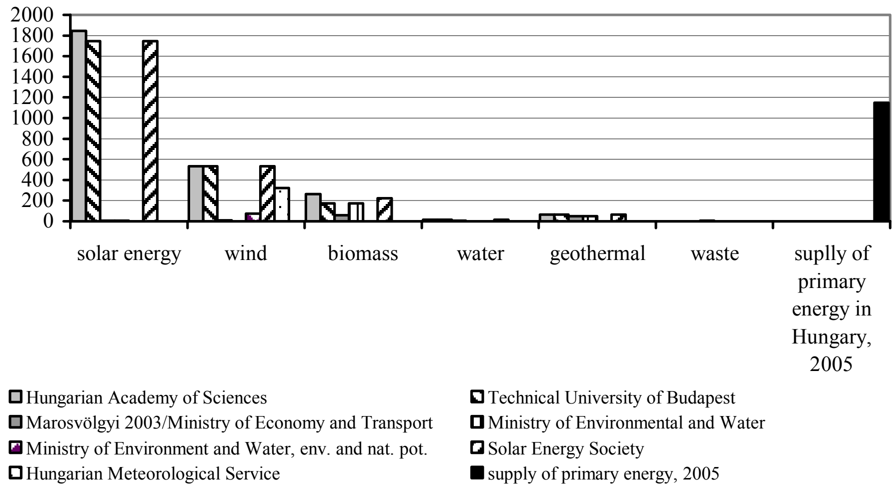
The basis of the energy supply of the micro-regions should be built in Hungary on the local sources of energy in a way that the use of natural gas should be decreased, and all products – mainly those treated as waste so far – should be utilised for energy production that could weaken the dependence of the respective micro-region on the national distribution systems. In order to achieve this goal, a significant part of the villages and municipalities should be supplied with remote heating, district heating and electricity produced mainly from biomass and other renewable sources of energy. The necessary energy is provided by biomass and other renewable sources of energy. The use of the fossil energy sources by the inhabitants and the fees to be paid for the services would simultaneously decrease.

Presently Hungary is dependant on the imported energy carriers to a large extent. While the average of the EU 27 is 50.1%, in Hungary 60.8% of the used energy is imported energy. On the other hand, the gas network of Hungary is on of the most extended in the world, almost 90% of all municipalities are connected to the national gas network. From the fossil sources of energy, almost 80% of the natural gas comes from Russia, which is not favourable for the safety of supply, as the events of the recent years indicated. Natural gas, due to its relatively high price, is subsidised in Hungary, which worsens the economical use of the renewable sources of energy in energetics.

To see the possibilities of the use of renewable energies in Hungary, the chart below demonstrates the potential of the different sources of renewable energy (*Figure 1*).

Figure 1.

Estimated potential sources of renewable energy, PJ/year



Source: Compilation by the Energy Club, Energy Centre Non-Profit Company.

The electricity production capacities using renewable sources and wastes have only increased substantially in the field of wind energy and biomass, despite the great potentials. The use of solar energy is not even visible in the chart of *Figure 2*.

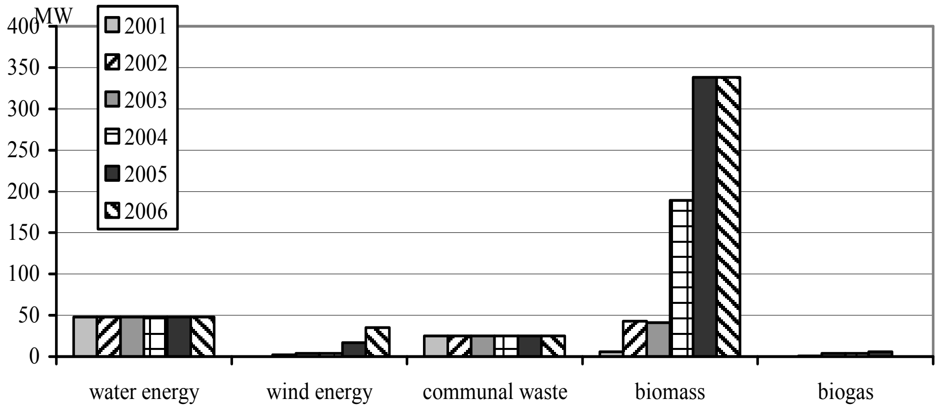
The forecasts clearly demonstrate that the sources of renewable energy are not a real alternative, but they might be of help for the solution of the energy problems of the micro-regions, by the utilisation of the so far unused local resources. In order to illustrate the energetics potential of the micro-regions, it seems reasonable to mention the future development of the capacity of the power stations in Hungary.

Presently the total capacity of all power stations in Hungary is approximately 8,900 MW. Of this, 85% is the capacity of large power plants and 15% of the electricity is provided by the decentralised small power plants. By 2025, due to the closedowns, a total of 3,850 MW capacity at the large power plants and 1,130 MW at the small plants are expected to remain. The demand for new power plant capacity until 2020 will be approximately 4,000–6,000 MW.

Looking at the tendency of the national primary energy consumption, the further increase of the share of natural gas is forecasted, together with the moderate growth of the proportion of renewable energies (*Figure 3*).

Figure 2.

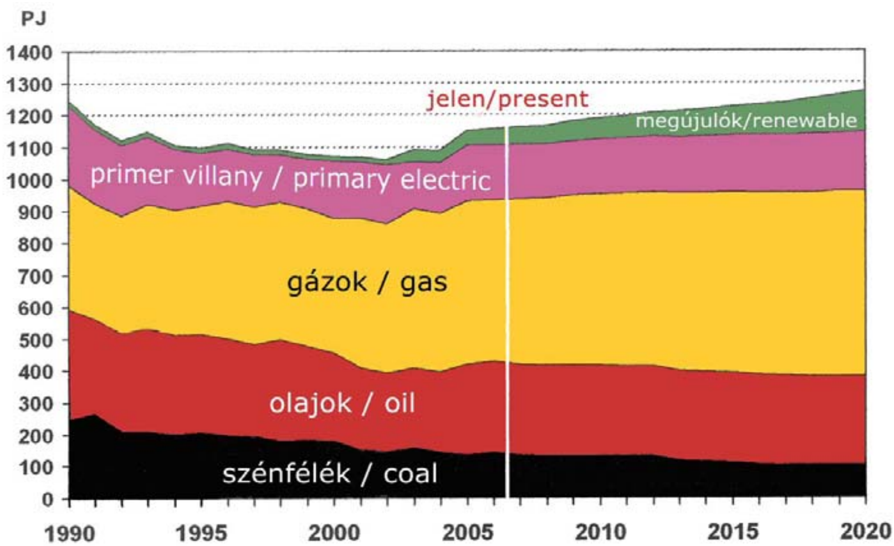
Electricity production capacities built on renewable sources and waste



Source: Stróbl, 2009.

Figure 3.

Expected national primary energy consumption in Hungary



Source: Compilation by the Energy Club, Energy Centre Non-Profit Company.

Before the analysis of the use of renewable energies in power plants we have to mention the requirements of the EU 27. According to the approved EU directive, the proportion of renewable energies must be raised from the 8.5% in 2005 to 20% by 2020. For Hungary the requirement is an increase from 4.3% in 2005 to 13% by 2020. However, this does not relate to the use of primary energy of electricity but to the end consumption. End consumption also contains, in addition to electricity, heat and the fuels for the engines. The proportion among these, however, is not defined.

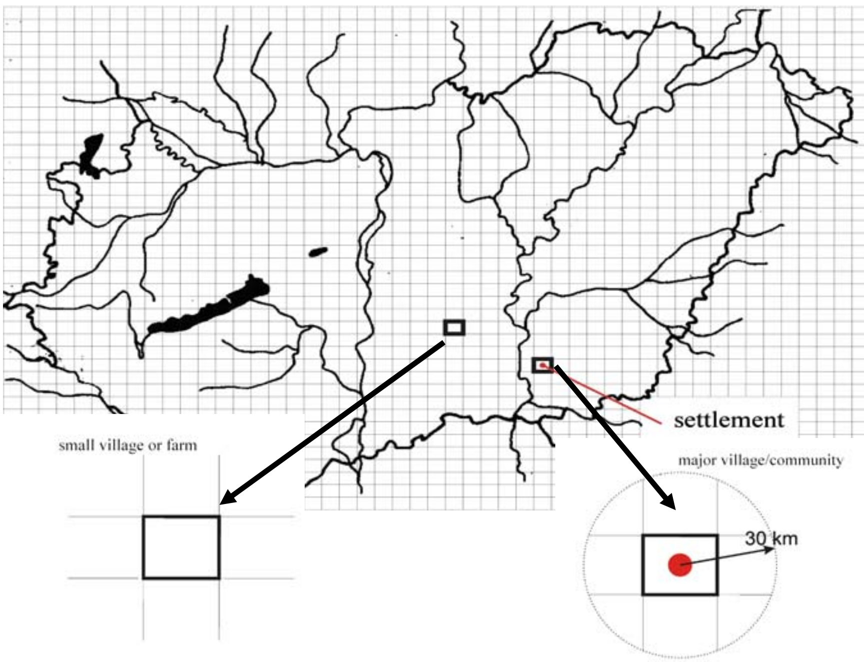
A tendency at the international scene is the proliferation of small and micro power plants in addition to the large establishments. The smaller investment needs, the locally available sources of energy, the lack of the maintenance costs of the national electricity network and the relatively short period of return on the investment are all factors promoting small local power plants. If we add that the integrated intelligent electricity supply systems (the so-called virtual power plants) are also becoming widespread, the establishment of small capacity energy production plants in the micro-regions is appreciated. In addition to electricity, the heat used in the family households is also a considerable item. In the 3,100 municipalities of Hungary approximately 4.5 million families live, so a dominant item of the energy used in the households is heating and the use of hot water. From the average energy consumption of a detached house, 70% is heating, 10–12% is hot water and only the remaining part (lighting, cooling, washing and other electric devices) requires electricity directly. Approximately 600 thousand homes are connected to the remote heating network of Hungary, the rest have separate heating systems, using primarily natural gas heated devices.

The emission of CO_2 must be decreased to 50% of the 1990 level according to the EU guideline, so a growing proportion of renewable energy in the consumption of the micro-regions should be achieved for the satisfaction of the demand for heat locally. Where the by-products of agricultural production (animal husbandry, cereal and other plant growing) can be used in energy production – e.g. operating engines with bio-gas, heat and electricity can be produced –, the substitution of fossil energy can even improve the profitability of the basic activities by the electricity sold to the national electivity network.

In order to see what renewable sources of energy are available and for what they can be used economically, a national energetics survey by micro-regions should be made (*Figure 4*).

The energy balance of each element of the network must be recorded. The volume of electric energy and heat consumed within the element must be measured. From the demand for energy within the respective element, heat can only be considered if consumed locally, whereas electricity can be sold through the network, if a surplus is produced in addition to the local consumption. If the demand for heat is smaller than the capacity of production within the catchment area of the micro-region, the rest can be used for other purposes than heat production. If the demand for heat is larger than what can be produced locally, the missing part must be "imported", by the purchase of natural gas for example.

Figure 4.
Calculation of the energy balance of micro-regions



Source: Penninger, 2009.

If the demand for electricity is smaller than the production capacity of the local resources, the surplus can be sold through the network, and if the demand exceeds the local capacity, only the difference must be purchased from the network.

The making of this database can be the foundation of the structure of the local energy production, and is also serves the assertion of the principle of subsidiarity, inasmuch as decisions can be made on the spot on the economical use of the local sources of energy like wind, solar, biomass or geothermal energy. This also necessitates the establishment of associations in the micro-region and the respective settlements for the production and use of energy. In the case of biomass, agricultural by-products or plants grown for energy production within a circle of 20–30 kilometres around a settlement can be used economically.

Energy production in the micro-regions from renewable energy

In the micro-region, in accordance with the international trends, decentralised energy production should be developed. The size of the locally available sources of renewable energy should be examined, separately for biomass, biogas, solar, wind and geothermal energy.

The use of primary energy of Hungary is 1,130 PJ/year; biomass can provide 150–260 PJ/year at national level. The use of this resource is the vested interest of the national economy. The development of the first generation technology of biomass use has finished, but this does not mean that the devices necessary for this technology are produced in Hungary; almost all of these are imported.

The development of the second generation technology of biomass use is underway, and the Hungarian research places could more insensitively join in this development. The development of this technology aims at the production of gases, fluid and solid energy carriers from biomass, using combined procedures.

The agricultural lands in Hungary are 5.864 million hectares, which is outstandingly high in Europe, if we calculate agricultural land per capita. Of this area, 77% is plough land, and 18% grassland. The remaining 5% is vineyards, orchards and vegetable gardens. For the growing of energy plants, approximately 1 million hectares are available. The table below is to illustrate the average yields of some agricultural by-products and energy plants (*Table 1*).

Table 1.

Average biomass yields in Hungary

	Annual yield (W=15%) t/(ha*a)	Gross annual amount of energy GJ/(ha*a)	Oil equivalent l/(ha*a)
By-products			
Forestry	1.0	15.5	431
Cereals straw	5.0	72.5	2,014
Rape straw	3.5	50.8	1,410
Meadow hay	4.0	58.0	1,611
Energy plants			
Fast growing trees	12.0	186.0	5,167
Cereals	12.0	174.0	4,833
Fodder grass	8.0	116.0	3,222
Chinese reed (3 years old)	15.0	217.5	6,042

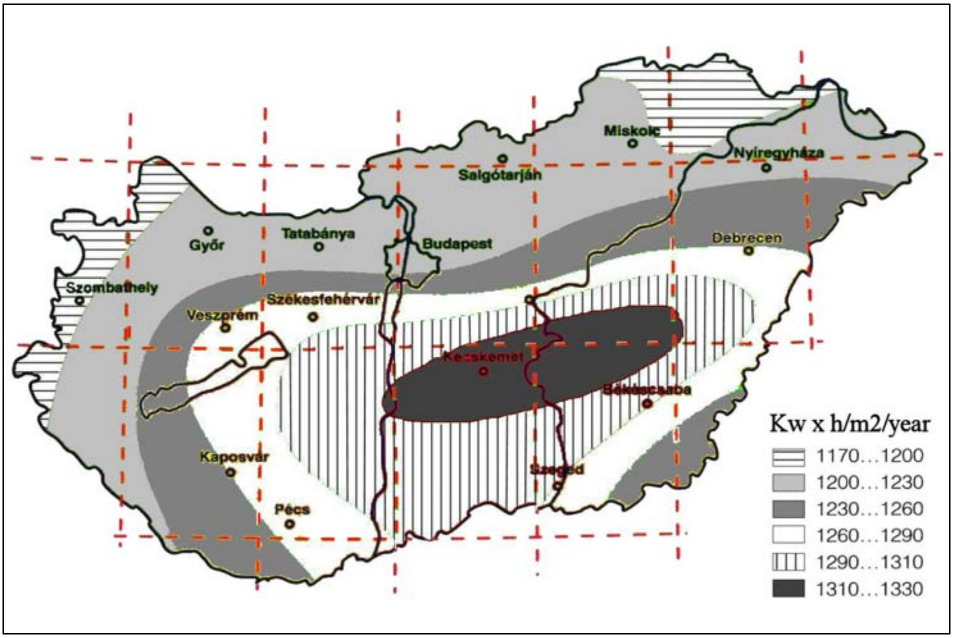
Source: Data of the Energy Club.

The annual biogas production capacity of Hungary is 2.3 billion m^3. The natural gas consumption of the households is 4.6 billion m^3/annum. It is worth looking at the possibility of thermal and electric energy production, and preparing for the manufacturing of the necessary devices in Hungary. Hungary had a considerable capacity of energetics machinery production before 1990; if adequate R & D was carried out and targeted support provided, Hungary could prepare for the manufacturing of devices marketable in large quantity.

The use of solar energy is perhaps the most debated issue of the renewable energies in Hungary. The solar energy potential of Hungary is 1,175–1,300 kWh/m^2/year, see *Figure 5*.

Figure 5.

Breakdown of solar energy in Hungary



Source: http://www.geoheat.hu; http://www.weishaupt.hu

Comparing the specific investment costs, we can see that the use of solar energy is one of the most expensive ways of energy production for the time being:

– solar power plants 1–2 MW; 4,500–6,000 Euro/kW; annual hours of use 800–1,200.

– biomass heating 15–25 MW; 2,100–2,400 Euro/kW; annual hours of use 5,000–6,000.
– wind power plant n x 3–5 MW; 1,000–1,200 Euro/kW; annual hours of use 1,700–2,000.

The tendencies of the recent years, however, show that the specific costs of energy production with solar cells has continuously decreased. Presently the specific costs of solar energy are 2 or 3 times higher than the retail prices, but the two costs are estimated to be equal by 2020 and by 2040 electricity produced by solar cells will be 30 to 40% cheaper than the retail price of electricity. Hungarian R & D thus should already deal with the development of the production technology of solar cells, as a considerable demand is expected in their market within 10–15 years. In addition to the manufacturing of photoelectric solar cells, the production of related electric devices could also be done by Hungarian developments. However, photoelectric electricity supply is only economical if transport distance is not larger than 2–3 kilometres. There are several possible areas for the use of photoelectric systems in agriculture: irrigation, pumping of water, circulation of the water of fish farms, electric milking machines of dairy farms etc.

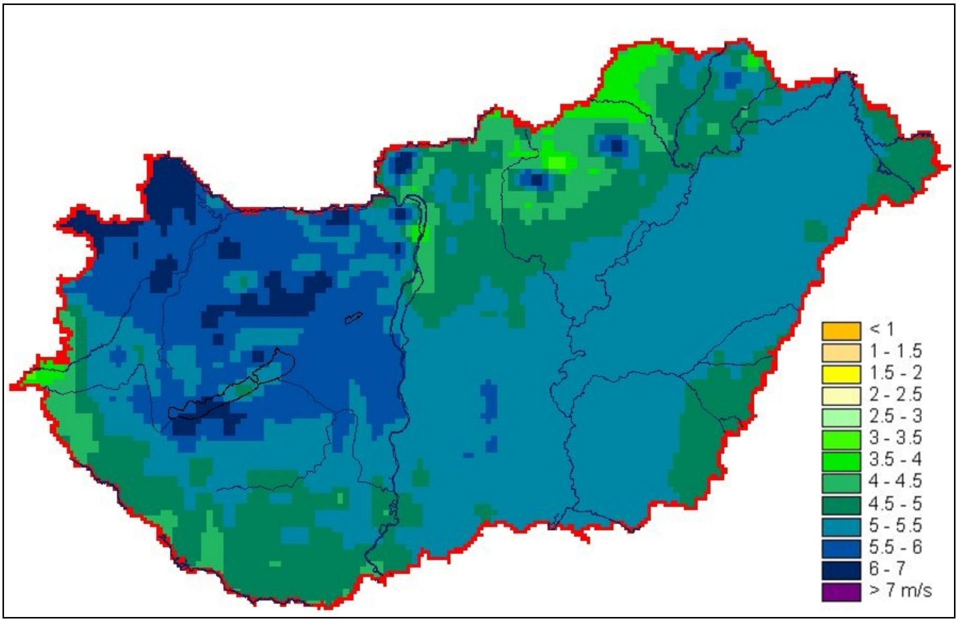
The solar collectors can be used for hot water production, and for auxiliary heating, by which a part of the natural gas can be substituted. These devices are called active thermal solar energy using devices, and they can be applied, in addition to heating water and buildings, for absorption cooling and in combination with heat pumps.

Solar energy can be used in agriculture for heating greenhouses and stables, for drying agricultural products and for producing technology hot water. The return on the investment is 5–10 years in greenhouses, 1–2 years in the case of simple crop driers and 6–8 years for integrated driers, in the case of technology hot water production it is also 6–8 years and for heating homes it is 8–10 years.

For the utilisation of wind energy, wind power plants are continuously built in Hungary, the total capacity of these already exceeds 100 MW. In order to maintain the regulability of the Hungarian electricity system, the maximum total capacity of wind powers stations is set at 330 MW for the time being. In the beginning the capacity of wind power plants did not exceed a few hundreds of KW-s, now plants of 3–5 MW capacity are also built. In addition to electricity production, the units of smaller capacity can be used for irrigation, the driving of water pumps, while the establishment of larger capacity can provide a more balanced energy supply if they are equipped with energy storage device. The map of Hungary featuring the potential use of wind energy is shown in *Figure 6*.

Figure 6.

Average wind speed at a height of 75 metres in the territory of Hungary



Source: Hungarian Meteorological Service.

Recently, because of the disparities of the production and consumption of energy due to the changes of the wind speed, the surplus electricity is used for the production of hydrogen. The technological solution for this is sought by several researches.

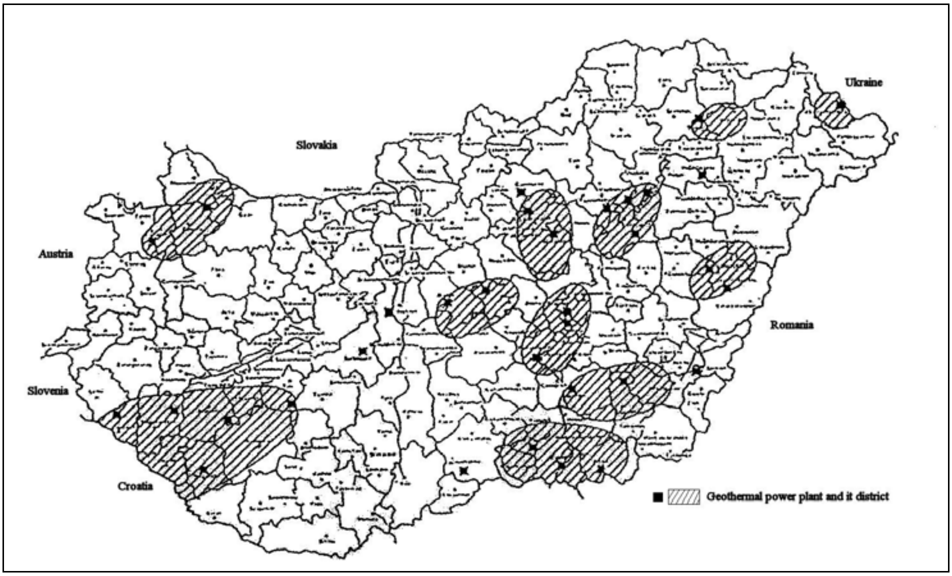
The use of geothermal energy is less recommended for electric power production by researches surveyed in Hungary, although systems using the Kalina cycle and the Organic Rankine Cycle have been built in several countries, mainly by EU supports. The survey carried out in Hungary designated 10–11 potential districts where the economic calculations may suggest the establishment of geothermal power plants (*Figure 7*).

However, even in the best case Hungary will have a total of 100 MW energy from these smalls-scale power plants, which is just over 1% of the gross electric energy consumption of the country. Hungary has considerable assets of thermal water and more than 1,300 wells have been bored so far, so this source of energy as thermal energy for heating cannot be neglected. This thermal energy should be used for heating in the first place, which could lead to the substitution of a significant amount of natural gas and which is absolutely advantageous for climate protection considerations too.

Heat pump is a device used for heating purposes, but its operation needs electricity. Heating with heat pump is economical if the decrease of the operational costs achieved by the substitution of the energy carrier exceeds the auxiliary expenses – depreciation, maintenance etc. – of the heat pump, which are higher than the average. It is recommended if the electricity demand of the heat pump can be covered from renewable energy, for example with gas engine fuelled by biogas. In this case energy saving and climate protection effect are both present. The most effective use of the heat pump is floor heating, but it can also be used for larger radiators. The Hungarian heat pump capacity was 25 MW in 2006, it is expected to reach 75 MW by 2010 and a total output of 300 MW is forecasted for 2025. Approximately 100% heating energy requires some 20% electricity.

Figure 7.

Recommended districts of geothermal power plants in Hungary



Source: Penninger, 2009.

The deposition of communal waste is a problem growing in importance in the micro-regions too. The use of this waste for energy production can be done in special power plants built for this purpose, by thermal neutralisation and the concomitant significant decrease of the volume of waste. The latest estimations calculate with approximately 50 MW output in the coming 10 years.

Another source of environment pollution in the municipalities is sewage. Biogas coming from sewage treatment is not only suitable for electricity production but also for sales in the form of heat. In the decades to come it may become a dynamically developing sector.

We have looked at the most typical possibilities of the micro-regions for energy production, with the intention to assist the mapping of the possible energy potential of the micro-regions by careful planning. The energetics technologies necessary for this must be adapted to the local endowments, and for the production of the necessary energetics devices the Hungarian small, medium-sized and large enterprises most be developed to a level where they are competitive on the international markets, by R & D & I (research, development and innovation).

Research and development tasks in the renewable energy industry

The Hungarian research and development sector is usually not competitive internationally, unfortunately; the number of outstanding performances has considerably decreased. The R & D intensity in Hungary is only 1.0 (in 2006), as opposed to 2.35 in Germany and 2.56 in Austria – but the average of the EU 27 is also much higher, 1.84.

The manufacturing of energetics machinery has been built down; the demands are satisfied by import, mainly. The directive of the European Union for the use of renewable energy is a serious challenge for Hungary, as are climate protection and the decrease of the use of fossil fuels. The intellectual resources are still given for the establishment or strengthening of the Hungarian owned small, medium-sized and large enterprises by targeted R & D supports. Of course the foreign owned companies must also be included in this programme in a way that they should contract the major part of the R & D related to their activity in Hungary.

Research and development, however, can only be effective in close cooperation with the development of training and higher education. The future generations must lead an energy and environment conscious way of life so that the resources should be used as efficiently as possible, from Hungarian sources, and so that the least possible amount of energy should be imported from abroad.

For the development of energetics in the micro-regions and the economical use of the sources of renewable energy in their catchment area it is indispensable to set up a consultancy service in the framework of R & D & I in the respective regions that is able to help in the calculation of the energy balance and the selection of the most appropriate technology.

One of the most important elements of the efficient use of energy is the considerable decrease of the demand of energy for heating. This means the modernisation of the existing buildings and the construction of new ones with up-to-date technology. The specific heating energy consumption of homes in Hungary is approximately 250 kWh/m^2, while this figure is only 150 kWh/m^2 in the EU 15; that of a newly built modern home is only 67 kWh/m^2. This is why the support of the energy saving by the inhabitants should be of selected priority, by the modernisation of the energetics of the buildings, the manufacturing and distribution of energy saving consumption devices and the development and manufacturing of heat and electricity producing equipments using renewable energy.

Production of engine fuels from sources of renewable energy

The so-called green fuel responsibility of Hungary is 5.75% by 2010, which means that engine fuels should contain a growing share of fuels coming from renewable energy sources. Petrol can be diluted with bio-ethanol, for the production of which sugar beet, maize and wheat are suitable agricultural products. Of course crops grown for nutrition purposes should not be mixed into the fuel, what should be used are plants definitely grown for energetics purposes. The production of these is only possible if producers integrate into associations, so before the technological investment contracts should be made for the purchase of an adequate quantity of products for at least 10 years. The production of small amounts is usually uneconomical.

Diesel can be mixed with biodiesel to meet the requirements. For oilseed rape growers, the use of the non-esterised biodiesel is possible with the mixing of higher order alcohols. The mixture of alcohol and rape seed oil can be used in compression ignition diesel engines. This way the farmers themselves can produce the fuel necessary for the operation of their machinery.

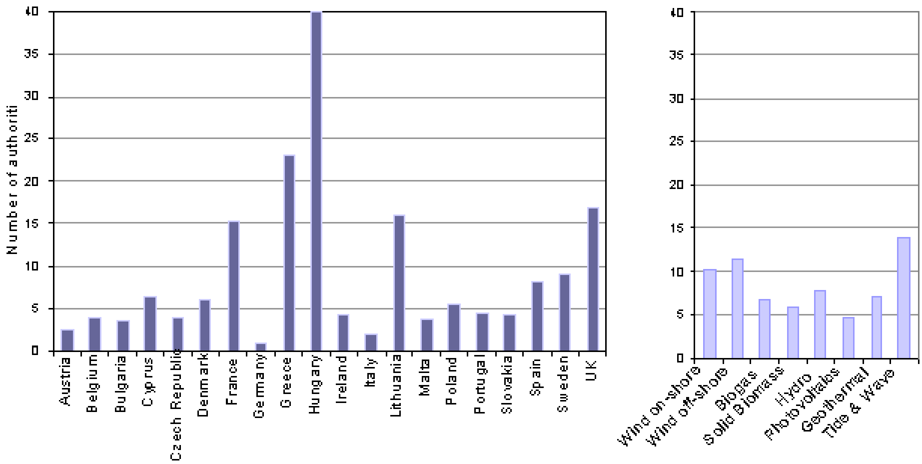
Licensing procedures and issues of the legal regulation

The licensing procedure of the energetics investment in Hungary is extremely complicated and problematic. In framework of the legal harmonisation within the EU, the Hungarian practice should be very soon adapted to the rules used in other member states of the Union. Below the threshold of 50 MW, the licensing procedure of the investments built on renewable energy requires the possession of 40 different permissions; in Germany 1 permission is enough, in Austria it takes 3, in the Czech Republic, Portugal and Slovakia 4, in Denmark 6 licences to start such an investment – these figures speak for themselves (*Figure 8*).

The licensing procedure lasts for 2 years in Hungary, cf. 4 months in Germany. A predictable and foreseeable legislation environment and supply guarantee are needed to promote the micro-regions to move towards self-sustaining energy production and to allow them to be able to define lower heating and electricity supply fees for the inhabitants.

Figure 8.

Licensing of systems using renewable energy in some EU member states



Source: Promotion and growth …, 2008, 68.

A radical deregulation of the licensing procedure is needed. In order to achieve a more intensive use of renewable energy in Hungary, the transformation of the purchasing system is necessary. Greater support should be given, but in a differentiated way, only to those producers that match the Hungarian conditions the most. Investments aiming at the flexibility of the electricity system should be supported. For small and micro power plants the simplification of the licensing procedure is even more important, for which the range of non-license dependant machinery should be defined. If many small power plants are established in the municipalities of the micro-regions, they should be integrated into so-called virtual power stations, allowing them to operate as if they were one single large power plant. This would also strengthen the safety of supply, allowing the amount of security reserves to be decreased. Such a virtual power station consists of several small producers, storage facilities and flexible production capacity. The point is that such a virtual power plant should be suitable for the keeping of a timetable, the support of the regulation system and the complete restoration after breakdowns.

Furthermore, the taxation system should encourage the implementation of energetics objectives, and the supports should also be awarded in order to promote the domestic job creation, the increase of the production and the introduction of new technologies.

Energetics machinery and equipment suitable for the micro-regions

The use of biomass can take place in the form of solid fuel or gas fuel. In both cases the chemical energy bound in the fuel can be utilised by its transformation into heat. In the case of solid fuel this may be direct incineration or transformation into gas. In case of incineration, steam, hot water or warm water can be produced in the incinerator for direct heating purposes.

Steam, however, can also be used for electricity production in steam turbines or in steam engines through the connected generators; in addition it can give heat as well. A new technology is also becoming more and more widespread, namely that a so-called external combustion engine is operated by incineration – this is called Stirling engine –, which is also suitable for electricity and heat production.

Gas-producing technologies from biomass are not fully worked out yet, but there are such machineries in operation already. The gas produced from biomass can be used, after purification, as a fuel of steam engines or combustion engines. Fuel cells have been a promising field of the use of such gases recently.

The wind power plants manufactured range from a few tens of kW to 3–5 MW output. The machineries of larger capacity are all imported, but the production of smaller units could be done in Hungary as well.

The use of solar cells for electricity production requires, in addition to the photoelectric panels, charge regulators, inverters and batteries. The manufacturing of several of these elements could be done in Hungary with adequate R & D support. Solar collectors with the integrated hot water tank, and the auxiliary heating equipments are a mature technology whose manufacturing in Hungary is feasible. Geothermal energy should primarily be used for heating purposes with the use of heat exchangers; the production of electricity would require substantial Hungarian R & D for the preparation of the manufacturing of adequate turbines. The penetration of the use of heat pump is expected, the production of the components for its manufacturing is possible in Hungary.

The Theses of the New Energy Policy of Hungary forecast a significant growth in the Hungarian electricity production from renewable energy for the coming 20 years (*Table 2*).

Table 2.

Electricity production from sources of renewable energy in Hungary

	Electricity production from renewable energy (GWh)		
	2003	2010	2025
Geothermal energy	-	100 (15 MW)	390 (80 MW)
Solar collectors	-	-	-
Wood (in biomass-fuelled power plants)	109	1,490 (230 MW)	2840 (1,490+1,650) (440 MW)
Energy plantation (in biomass-fuelled power plants)	-		
Wood, forestry waste	-	-	??
Biomass from other sources	-	-	-
Biogas	18.7	70	128
Hydro energy (4,150 hours/year)	171 (195)	233	300 ?
Wind energy	3.6	300–375	1,050–1,175
Photoelectric energy	0.07	10	20
Total, without incineration of waste	301.9	-	-
Incineration of waste	67.2	107	200
Bio-fuel			
Total	368.97	1,760–1,831	4,900–5,030

Source: Theses of the New Energy Policy of Hungary for the 2006–2030 period. Chapter 12.

After looking at the energetics machinery and equipments, a few words have to be said about the sources of energy suitable for energetics purposes. These are mainly biomass, communal waste and sewage mud that should be available. In order to achieve an energy production profitable and economical in the micro-regions in the long run, contracts should be made for at least 10 years for the guaranteed procurement of the raw materials. This way we can avoid that several settlements plan their energy production on the basis of the same or partially the same source of raw materials. Considering that the different plant cultivation technologies are excellently elaborated, these technologies should be adapted to the respective micro-regions.

The by-products of agricultural production and animal husbandry can be made suitable for energetics use, and the produced electric energy and heat can bring incomes that can even compensate for the uneconomical basic activity and make the businesses profitable. In all cases it should be carefully calculated how profitable the production of electricity can be, in addition to the production of heat. By the substitution of natural gas, costs can be decreased and the viability of the micro-regions significantly improved.

The collaboration of the micro-regional actors for bioenergetics purposes can safeguard the protection of the environment and the landscape, more local jobs can be preserved and the manufacturing of domestic equipment can even lead to job creation; the possibility of auxiliary incomes may speed up the catching up of the rural areas.

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ENVIRONMENTAL INDUSTRY AND THE CONCEPT OF A SUSTAINABLE CITY – ENVIRONMENTAL INVESTMENTS IN BUDAPEST

Gergő Czeglédy

Introduction

The global natural, economic and social changes of these days – such as climate change, financial., food and energy crisis and other critical ecological processes – have raised the question in many researchers, academics, politicians and interested citizens: what could be the solution to the extremely complex issue of environmental industry and sustainable development? Many have stated the necessity of a sort of paradigm shift, in which sustainability in general, the assertion of the environmental interests, some kind of "green way" is in the foreground of the ideas. Each global change has sooner or later palpable impact at the local level, from which Hungary is no exception, either. Coming from the historical traditions and the spatial structure of the country, the dominance of the capital city is typical of Hungary, which is visible in the concentration and performance of both economy and the human capital. Besides being the administrative, economic, social and cultural centre of the country, in fact, an outstanding centre of the international economic and cultural life of East-Central Europe, Budapest produces almost half of the total gross domestic products (GDP), which is approximately two and a half times more than the GDP of the second most advanced Hungarian region, West Transdanubia.

The related data and the global changes all underline the importance and topicality of the issue chosen as the topic of this essay. The analysis looks at the environmental developments in Budapest on the basis of available information. An important objective of the study is to give a comprehensive picture of the *general situation of environmental industry* in Budapest, with regards to the new challenges and opportunities in the sector. The comparative analyses pay a special attention to the aspects of environmental industry as well, as both the opinions of the experts and the present tendencies suggest that environmental industry can be a breakout point for Hungary; also, environmental industry has substantial positive social and environmental impacts. All these characteristics make environmental industry suitable for the promotion towards sustainability and a more liveable world.

An external drive of the developments is the fact that the region has its last chance for developments of this volume from EU financed resources, later it will not be eligible. It is probable that the international economic situation will lead to the general decrease of the amounts of support in the medium run, although the effect of this is not palpable yet. Another difficulty was caused by the fact that the capital city of Hungary had no approved budget for almost five months, due to the equal number of votes by the two large parties in the general assembly. The prolonged beginning of the year without an approved budget jeopardised the implementation of planned investments and also caused problems in the solvency of the municipal institutions.

The selected importance of the development projects comes from the fact that they allow the implementation of investment of a volume that Hungary could not afford on its own in the present difficult situation of the national and the world economy. Given the expected decrease of the amount of resources, it is obvious that the projects co-financed by the European Union are unique opportunities; no similar development can be expected in the near future. If these projects are not successfully implemented, the problems to be tackled by them could worsen and their solution could be postponed for lack of resources.

The recognition of the above problems led to the fact that the region of Central Hungary overloaded itself with projects, so more problems arose in connection with the problems than was expected. This not only caused delays in planning in implementation but also led to the statement of open criticisms. These investments offer a good opportunity for the decrease of unemployment exacerbated by the economic crisis, because they create a substantial number of jobs in the implementation phase. This way environmental industry can contribute not only to the implementation of the developments but also to the easement of the symptoms of the economic crisis.

As a consequence of the economic performance of the capital city we have to consider that Budapest will not be eligible for the presently available supports in the next programming period of the European Union, i.e. after 2013. This is one of the reasons why the number of investments using the co-financing of the EU has multiplied, as the capital city of Hungary will not be eligible for these resources in the next budgetary cycle, due to its changed development indices. It is a question whether Budapest wishes to implement too many projects and how it will be influenced and affected by the economic crisis, the political instability, the lack of the budget of the capital city, the possible solvency problems, the fluctuation of the exchange rates etc.

Finally, with a view to the above statements, the analyses map the social, economic and environmental impacts of the different developments and rank the investments mentioned in the study on the basis of this holistic view, always keeping the requirements of sustainable urban development in mind.

The situation of environmental industry in Budapest

The environmental developments of Budapest and its surrounding are important target areas of the environmental industry, the implementation of which may trigger positive external effects as well. The dynamics of the development of environmental industry depends to a large extent on the acknowledgement of the sector; environmental developments may improve social embeddedness, just like the planned projects can promote the appreciation and strengthening of the role of environmental industry.

Of the environmental industry in general

The task of the *environmental industry* is the manufacturing of products and provision of services that assist the measurement, prevention, decrease or avoidance of environmental damages. Because environmental industry is organised on market grounds, market actors can accept them much easier than the traditional tools. In some countries of Western Europe a considerable proportion of the GDP is produced by the environmental industry, still the literature on this topic is rather deficient.

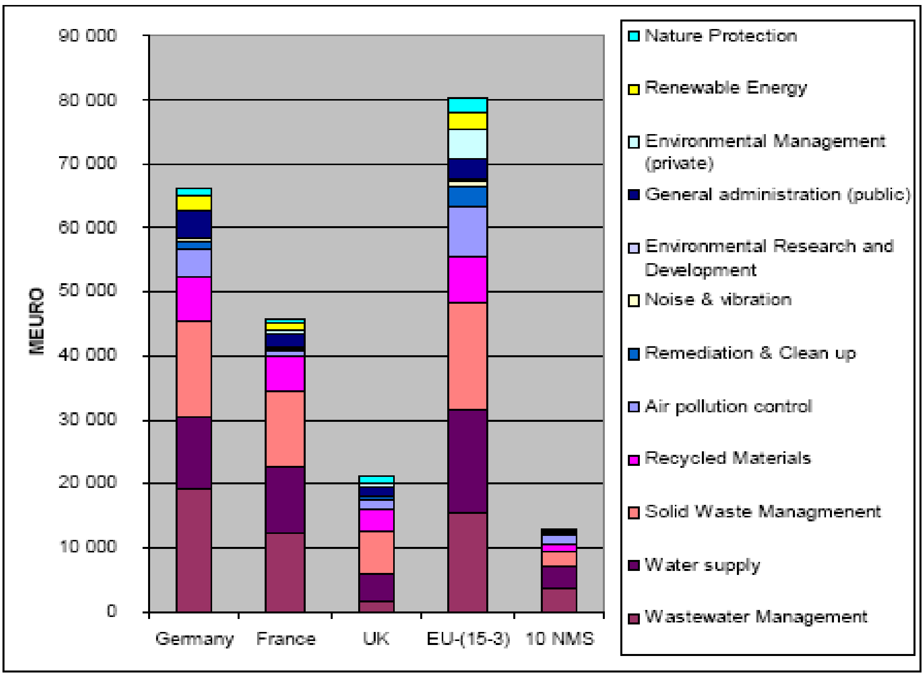
Analysing the situation of the environmental industry and the environmental developments from the aspect of environmental industry strategies, environmental industry can be divided into three major fields:

1. sewage treatment;
2. cleaner technologies and products;
3. resource management (*WTO* 1998, *OECD/Eurostat* 1999).

In financial respect the first field is far the most important, as this involves the wide-spread and often applied so-called “end of pipe” technologies. The turnover of the activities of environmental industry can be broken down by the sub-sectors of environmental industry as shown in *Figure 1*. *Figure 2* shows not only the significance of the sub-sectors but also their breakdown by member states. It reveals that the three major countries in the turnover of environmental industry are Great Britain, France and Germany. The countries of the EU 10 lag behind the EU 15 in this respect. The report of the European Commission DG Environment – Ernst & Young (2006) also shows that the sub-sectors with the largest turnover include services and activities related to sewage treatment and waste management, and the protection of air cleanliness. On the whole we can say that the share of the environmental industry from the GDP in Hungary – 2.7% – is around the average of the EU 25 (*Figure 2*). According to the data of the Hungarian Central Statistical Office, the turnover of environmental industry in Hungary was approximately HUF 340 billion, i.e. € 1.28 billion, calculated with the annual mean exchange rate of 2006 of the National Bank of Hungary (*Ernst & Young – European Commission DG Environment,* 2006).

Figure 1.

Revenues of environmental industry by sub-sectors and countries, in absolute value, 2004

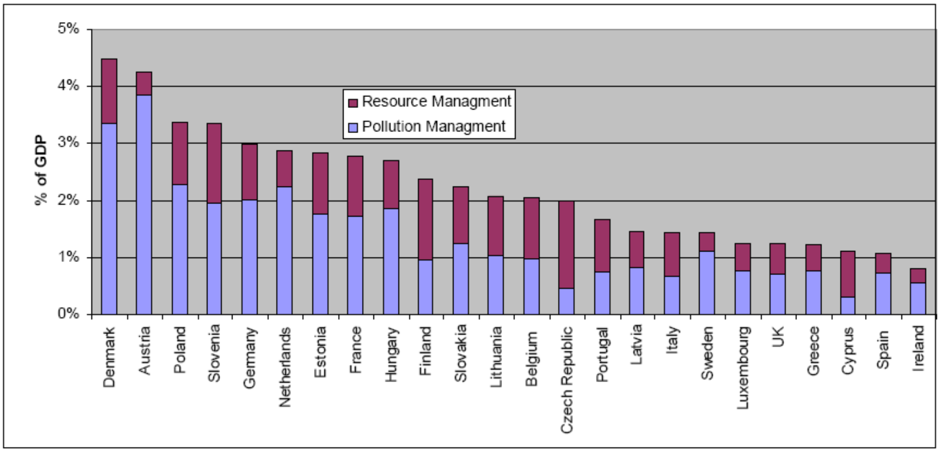


Source: European Commission DG Environment – Ernst & Young, 2006.

The turnover of environmental industry per capita shows a less favourable picture of Hungary. Although it is only Slovenia that precedes Hungary among the "newly acceded" EU 10 states, if we compare the expenditure of environmental industry per capita in Hungary to the most advanced Danish environmental industry, we can see that this amount in Hungary is only one-eighth of the value in Denmark (*Figure 3*).

Figure 2.

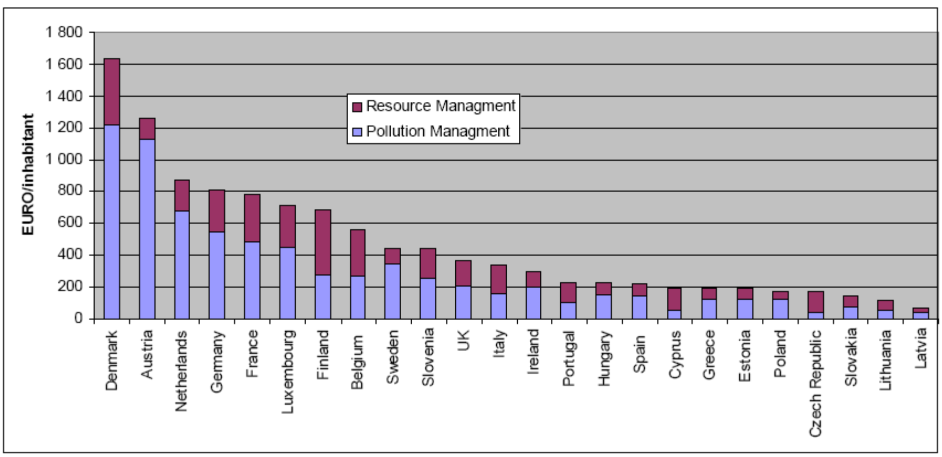
Turnover of environmental industry in proportion of the GDP, EU 25, 2004



Source: After Kollányi – Liska, 2009.

Figure 3.

Expenditure of environmental industry per capita, EU25, 2004



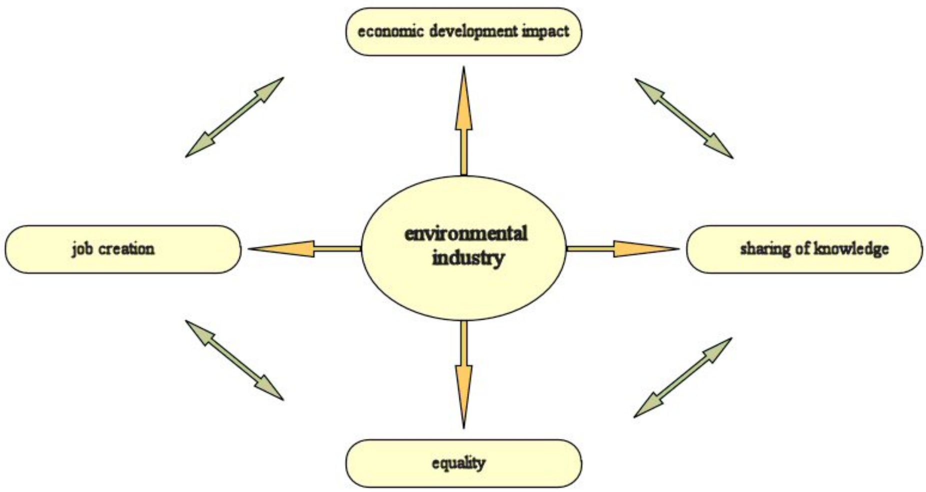
Source: After Kollányi – Liska, 2009.

External effects of environmental industry

Environmental industry may have several *external* effects, of which many are favourable, so-called positive effects (*Figure 4*). Aspects concerning the state of the environment are not featured in the figure, as they are among the targeted activities of environmental industry. Economic development effect involves the demand for raw materials and the supply of products and services generated by the environmental industry. They also include impacts on the financial market (e.g. credits taken up by the environmental industry companies). The dissemination of knowledge includes innovation, R & D activity, and national and international cooperations. The labour market effects related to the environmental industry and the related equality issues are also of selected importance.

Figure 4.

Positive external effects related to environmental industry



Source: by the author.

Environmental industry, on the other hand, has a large number of *negative external effects* as well. One of the most important of these is the *export of pollutions*. The respective countries may have two reactions to the surplus of emissions and the concomitant exceeding of the threshold values: they may raise the threshold limit values in order to save the expenses of damage recovery, or pay the expenses. However, as the necessary technology is usually not at the disposal of the respective country, it will probably contract an environmental industry company from an advanced economy for this activity.

The role of environmental industry in sustainable urban development

The economic and social factors concentrated in the big cities and the related negative external effects justify the local – more exactly city – level examination of the issues of sustainability. The different phenomena and events affecting Budapest – such as the problems caused by the gas crisis, the economic and financial crisis, the smog alarm etc. – and their consequences all underline the importance of the topic. The world tendencies suggest that by 2020 80% of the inhabitants of the planet earth will live in towns and cities. The issue is raised what role environmental industry can play in sustainable urban development (*Szokolay,* 2009).

Criteria of the European Union concerning sustainable cities

The *Leipzig Chart* for sustainable European cities was approved in May 2007, in which the objectives stated in the *Sustainable Development Strategy of the EU* (2001), the *Lisbon Strategy* (2000) and the *European Employment Strategy* (1997) were reinforced and adapted to the urban conditions. The European Union had already paid attention to the ideology of sustainable cities formerly, the result of which is the criteria that of course should in all cases adapted to the special local conditions.

1. Adequate financial background, careful economic management, exploration of the different opportunities available.
2. Improvement of energy efficiency, energy saving.
3. Use of renewable energy.
4. Application of long-life architectural structures.
5. Reducing the distance between homes and workplaces.
6. Improvement of the efficiency of public transport.
7. Decrease of the waste produced and increase of the proportion of secondary use.
8. Propagation of composting in the city districts with gardens.
9. Preservation of the circular character of urban metabolism and the improvement of the process of the material exchange.
10. Provision of the major foods from local sources (*Novák,* 2004).

The characteristics listed above reflect the environmental and economic dimensions of sustainability, but the ultimate objective and also the driving force is the improvement of liveability, the quality of life. On the whole it can be said that the consequences of globalisation and the concomitant competition will definitely have to be taken into consideration in the future, preventing, if possible, the emergence of the problems or at least decreasing their severity. Growing disparities are more and more often analysed these days – such are e.g. the phenomena of economic polarisation, segregation and exclusion. A new approach is needed then that is not equal to the approach of urban growth from an environmental aspect but is suitable for the following of a complex strategy, mixing not only the economic aspects but also equalisation and the interest of the environment for a sustainable – in this case "dwellable" or liveable" – future.

Ideology of the autonomous city

The study called *Autonomous City* by the Independent Ecological Centre (2004) states that although cities cannot become autonomous as regards the satisfaction of basic needs and the provision of raw materials, they can reach a higher level of autonomy in the legal and cultural sense than rural areas or settlements can. The statement comes from the idea that an increasing share of the world's growing population lives in towns and cities and the cities basically represent a consumption attitude. The products and energy used by the city inhabitants and the economic organisations cannot be produced in the territory of the city; cities can only satisfy their needs by the utilisation of the resources of a wider environment.

We can talk about an autonomous city then if the respective settlement uses the natural goods produced in the country in a sustainable way and feels itself responsible for the environment that sustains it. However, these days it is more typical of urban existence that the population living in improving financial conditions gets farther and farther away from the natural environment that it depends on. This is accompanied by the rising level of environmental burden caused by the transport and infrastructure needs concomitant with the spatial expansion of the cities, which has also promoted the birth of environmental industry by the keeping of the connected regulations and threshold values.

Concept of the sustainable urban development

The settlement model of sustainable development (*Ruzsányi,* 2005) requires the solutions saving the natural environment and using the resources in a thrifty manner. The essence of the concept is that it is necessary to control the use of space, by the regulation of the density of housing, on the one hand, and the assertion of the principle of integration, on the other hand. This approach is basically about the integration of spatial, urban and transport development. According to the study, the density of housing most suitable for the implementation of sustainable development is a density of buildings typical of the small towns. In this case the distance between the residence and the workplace is smaller, which improves the efficiency of technical and human infrastructure and the operation of the urban public services, the economics of urbanisation in the general sense, which contributes to sustainable development. Research findings revealed a strong negative correlation between urban density and the efficiency of the use of energy. If e.g. the density of population falls below 40-50 persons per hectare, the number and the frequency of the use of cars will increase. This related to the fact that the public transportation services are economically inefficient with small a small density of population, due to the low density of stops and lines. If the number of cars increases, this goes together with the increase of the amount of emitted CO_2, NO_x etc. and the rise in the occurrence of other negative externalities such as accidents or traffic jams. In the case of Budapest the environmental relevance of the transport investments and their role in sustainable urban development should be emphasised.

Creating a liveable city

The structure of the European cities has continuously changed during history, sometimes slowly and gradually, at other times more rapidly, due to different natural disasters and wars. The reorganisation of the cities should happen in a sustainable manner, and this move towards sustainability can be demonstrated if this process goes parallel to the minimising of the ecological footprint of the city. The practical implementation of the concept of dwellable city requires the solution of the following problems:

- Using up the different resources, decline of the natural and social values, deterioration of the quality of the built environment, lack of new values.
- Creation of a healthy residential, working and learning environment.
- Transport problems (traffic jams, complicated nature and congestion of public transportation).
- Decreasing number of pedestrians.
- Decline of bicycle traffic.
- Problems of the individual car use.
- Obsolete infrastructure networks, necessity to satisfy new demands (*Novák,* 2004).

The centre of the environmentally sustainable urban development is the preservation or improvement of the quality of life, to which environmental investments can make a substantial contribution. Environmental industry plays a dominant role in the complete implementation of sustainable urban development (*Paulussen–Wang,* 2005).

The situation of environmental industry in Budapest in the light of environmental developments

In environmental industry *reactive strategies* are typical in the whole of Europe, including Hungary, i.e. the dominance of developments aiming at the handling and decrease of the pollutions over the proactive strategies. This is partly the consequence of the fact that environmental industry activities depend to a large extent on the environmental regulations, on the one hand; on the other hand, in the case of projects with environmental development objectives the existence of available resources awardable through a tendering procedure, i.e. the priorities of the available development resources, determine to a great extent the character of the investments to be implemented, which is not always favourable for proactive environmental industry strategies or resource management (*Table 1*).

Proactive environmental industry strategies include preventive investments, i.e. not the environmental developments wishing to handle already existing pollutions. The move towards environmental sustainability seems to feature some contradiction among the environmental, social and economic dimensions, due to the counter-interest of the economy, in the sense that the vested interest of the operators using end-of-pipe technologies is the long-term preservation of the (volume or extent of) pollution to be tackled – this secures their revenues but does not lead us towards liveability and environmental and social sustainability (*Table 1*).

Within the development of environmental purposes, the largest in volume are *investments related to sewage treatment and waste management*, and *water supply*. These three field make approximately two-thirds of the turnover of environmental industry in the EU 25 countries, which is not surprising if we consider that the production of sewage and waste is the oldest of all problems requiring environmental industry solutions, whose importance is further increased by phenomena such as the population growth, urbanisation and the palpable tendencies of the consumption habits (*Kollányi–Liska,* 2009).

Among the most frequent reasons for the delays in the environmental investments featured in the essay we find the efforts to find a way out of the labyrinth of bureaucracy, the difficulties of coming to consensus during decision-making processes, tensions coming from the position of the capital city as a whole and those of the individual districts, the provision of self-financing, the lack of adequate social acceptance and the expected results of the impacts of the changing economic circumstances. The diversity of the stakeholders interested in the implementation of the projects and the quality of their relations system and contact to each other also fundamentally influence the opportunities lying in environmental industry.

In the case of investments featured in *Table 1*, the potentially distorting effect of the EU supports, i.e. the strikingly large number of the projects is due to the decrease in the amount of supports that the region of Central Hungary will be eligible and can apply for in the next programming period. In the preservation and improvement of competitiveness a more and more substantial role is played by the environmental developments.

Table 1.

Environmental investments of public use in Budapest and its direct surroundings

Environmental industry strategies	Investments	Phase of implementation	Category
Reactive	Reconstruction of the Orczy Garden	In progress	Green areas
	Sewage treatment plant of Csepel	In progress	Water
	Damage elimination in Üröm-Csókavár	In progress	Soil and subsoil waters
	Sewage treatment plant of the South Buda district	Under preparation, implementation until 2010	Water
	Canalisation in the South Buda district	Under preparation, implementation until 2010	Water
	Gas factory of Óbuda	Under preparation	Soil and subsoil waters
	Support or the elimination of environmental damages	Continuous	Other
	Quality enlargement of the sewage treatment plant of the North Pest district, and transfer of the sewages from the Buda side	In progress	Water
	Full canalisation of the built-up areas of Budapest	Under preparation, implementation until 2010	Water
	Long-term use of sewage mud	Under preparation	Waste

Table 1. (continued)

Environmental industry strategies	Investments	Phase of implementation	Category
Reactive	Implementation of complex waste management programme	In progress	Waste
	Revitalisation of small streams	Under preparation	Water
	Construction of underground line No. 4	In progress	Transport
	Development of the electricity network	Under preparation	Transport
Proactive	Large park and sports complex in North Csepel	Under preparation	Green areas
	Measures for the protection of the network of green areas in the agglomeration	Continuous	Green areas
	Protection and development of urban green areas	Making of support contracts expected in the 2nd half of 2009	Green areas
	Protection against floods and inland waters, surface canalisation for damage prevention	Under preparation	Water
	Implementation of the environmental programmes of the capital city and its districts	Under preparation	Other
	Programme for the modernisation and propaganda of remote heating	Continuous	Energetics
	Promotion of the development of systems built on alternative and renewable energy	Start of implementation: 2009	Energetics

Table 1. (continued)

Environmental industry strategies	Investments	Phase of implementation	Category
	Implementation of energy saving programmes of municipalities, micro-regions, institutions, companies and the inhabitants	Start of implementation: 2009	Energetics

Source: by the author after the Integrated Urban Development Plan of Budapest City (IUDP), 2009.

The environmental industry in the sustainable development of Budapest

The role of environmental industry in sustainable urban development

The sustainable urban development ideas, efforts and directives mentioned above also underline the importance of environmental industry. Taking the objectives of the EU recommendations and the formerly introduced characteristics of the environmental industry sector of the Union into consideration, a Budapest focused analysis was made for the assessment of the role of environmental industry in sustainable urban development, with special regard to the presently known different development projects and efforts.

Among the selected and examined development projects mainly those are featured that reflect the proportions typical of the environmental industry of Europe – i.e. the great volume of sewage treatment and waste management activities –, on the one hand, and also bear the special characteristics of Budapest, on the other hand, satisfying this way the directives requiring the preference, use and consideration of the local characteristics of sustainable urban development (*Table 2*).

The selected development projects of Budapest were classified according to the dimensions of sustainable development, along a scale from 1 to 9. On the basis of the scores given by experts' estimations, we can define the sustainable urban development index (SUDI) which is meant to express the level of sustainability of the individual projects. On the scale, scores from 1 to 4 mean negative effects, scores 6–9 show positive impacts. Impacts neutral from our aspects are given a score 5. The aspect of endangeredness is to demonstrate the chances of implementation of the projects in question. The maximum score of endangeredness is 27, which means that the implementation of the project is free from any problem. In this case it means that the project is not delayed in time and does exceed substantially the expenses defined in the original conditions. The selection of endangeredness is justified by the fact that the environmental, social and economic qualities of the investments are all meaningless if the project is not implementable.

Table 2.

Assessment of the selected projects on the basis of the given aspects

Development project	Environ-ment	Society	Economy	Endangeredness	Sustainable Urban Development Index (SUDI)
Underground line No. 4	7	6	7	7	6.75
Sewage treatment plant of Csepel	8	5	6	19	9.5
Implementation of complex waste management programme	9	8	6	21	11
Gas factory of Óbuda	9	7	6	17	9.75
Protection and development of urban green areas	9	9	5	23	11.5

Source: Calculations and edition by the author.

The assessment of the environmental aspects is not an analysis of the severity of the problem in Hungary; it is to look at how much an investment with environmental purpose targets a given environmental element or its condition. In the case of the economic dimension the dominant aspect was not the temporary job creation effect of the investment, it was factors like savings in time spent on travel; the improvement of accessibility as an economic development effect; the appreciation of real estates; the economic boost generated by the revenues from local business tax etc. Among the social aspects, most important were the impact on the quality of life and the role played in the shaping of attitudes.

The rank of the investigated investments by the SUDI suggests that the protection and development of urban green areas was given the highest score, i.e. this is the investment that best serves the objectives of sustainable urban development. The average of the SUDI for the five projects evaluated in the sample is 9.7; in general we can say that investments with above average score serve public purposes better and promote to a larger extent the implementation of the concept of a liveable city. The further examination of the index featured above is recommended, as its integration into the decision-preparation processes can play a significant role in the early phases of the future development projects.

A brief summary of the projects related to environmental industry

At the selection of the projects the goal was to analyse projects that cover the broadest possible range of environmental industry activities, at the same time to neglect those investments whose implementation is uncertain, due to their schedules.

Sewage treatment plant of Csepel

After its completion, this plant will receive more than half of the sewage produced in the capital city. The total costs of the investment is € 491 million, the capacity of the sewage treatment establishment is 350,000 m^3 per day. During the implementation, however, serious problems arose. Due to the severe breaches of the public procurement rules, the EU deprived Hungary of approximately € 40 million of this support. Expert reports attributed this to the differences in the comprehension of the EU and Hungarian laws. The support can be spent on other project elements with the consent of the state and the capital city, so this amount is used for the construction of the 3rd grade of purification (removal of N and P). This project – as all other projects of Budapest – was also jeopardised by the malfunctions of decision-making and the absence of the budget, due to the already mentioned equality of votes in the general assembly of Budapest.

Underground line No. 4

The project faced serious problems from the very beginning. The feasibility of the project was often questioned and the expenses were considered as exaggerated. During the construction, a landslip occurred at one of the ventilation shafts of the Tétényi street station, and the schedule is continuously delayed, by the latest communiqué the whole investment will not be realised before late 2012 (*by Gusztáv Klados, project director of the DBR metro directorate*, 9 April 2009). Further problems have emerged recently in connection with the lack of an independent engineer and with the cooperation with the BAMCO consortium. The difficulties are exacerbated by the fact that the European Commission has not approved of the submitted tender documentation until the completion of this essay, referring to professional deficiencies. The underground line No. 4 will play a significant role in the substitution of the surface traffic of the capital city and can also contribute to the favourable change of the modal split. The biggest deficiency in this respect is that the present investment does not contain and P & R facilities. The transfer of a large number of passengers from the roads to the underground can also have a positive impact on the air quality. The positive impacts on the environment, however, are not adequately communicated to the inhabitants. It is nevertheless obviously a project to be examined, coming from the volume of the investment, its costs and the number of population concerned.

Gas factory of Óbuda

The gas factory of Óbuda is one of the selected developments of Budapest. This spatial structural development affects one of the most precious Danube bank development sites of the capital city. In addition to monument protection, damage elimination will also be necessary so that the planned change of function should be implemented (e.g. a private university is also being built on the site). Buildings under monument protection are, among other things, the clock-house, the dry cleaner, the water and tar towers, and the electricity centre. The project does not require any resources from the municipalities or the capital city of Budapest, so it is not affected by the budgetary problems of Budapest. According to the plans of the legal successor of the polluter (Budapest Gas Works Co.), damage elimination will be finished by 2010. The development has a direct impact on 35,000 people.

Implementation of complex waste management programme

Major elements of this project are the development of the waste deposit of Pusztazámor, and the increase of the proportion of selectively collected waste. The organisation responsible for the financing of these programme elements is the Metropolitan Public Space Maintenance Company. The volume of communal waste is closely related to the performance of the economy. On the ground of this we could see a dynamic growth in the last ten years, in the near future stagnation is expected. This stagnation allows the capital city to better meet the requirements of selective waste collection. The selective waste collection islands remove not more than 2% of all waste produced in Budapest from the non-utilised circulation of wastes. This means that it is indispensable to increase the number of waste collection islands, as their efficiency decreases in proportion with the growing distances. The growth of the waste collected from the waste collection islands is slowing down; this makes the enlargement of the circle of disposable wastes necessary. Presently the resources spent on the prevention of the production of wastes are not enough for the achievement of significant results. The extended information of the population is inevitable for the increase of the support of the inhabitants and the penetration of the possible most environment conscious behaviours (*Environmental Programme of the Capital City of Budapest* 2007).

Protection and development of urban green areas

One of the most important elements of this project is the regeneration of the park called Népliget (People's Park). After its restoration this park – as a significant green area of the inner city of Budapest (this is the largest public park in the capital city) – could decrease the negative effects of the urban agglomeration process, such as noise stress that has become part of the urban lifestyle by now; and air pollution. Despite its large size, the park is underutilised, while the other two large parks – the Margit Island and the Városliget – are overused, so a prerequisite of the renewal of these two parks is the decrease of their stress in which the Népliget Park can have a significant role. At the same time, the protection of the natural values should not be subordinate to even MICE tourism, in which the park can only play a limited role. The reason for the underutilisation – besides the deteriorated condition of the park – is that it has no organic contact to the other parts of the city. In the remedy of this situation, the reconstruction of the Orczy garden can have a role.

Regional environmental impacts of the environmental investments and developments in Budapest

It comes from the special situation of the *region of Central Hungary* that the investments in Budapest may have a considerable impact on the agglomeration, and also on the whole of the region; environmental investments are not exceptions in this respect, either. The environmental investments implemented in Budapest can make a complex contribution to the improvement of the competitiveness of Central Hungary. The projects introduced in the previous chapter improve the conditions of employment indirectly, by creating more favourable conditions for the industrial investments. Budapest has a dominant role in the economic and social life of both the region of Central Hungary and the whole of Hungary. In the next programming period, due to the development level of the capital city, less resources will be available from the European Union for the whole of the region – including its less developed settlements –, which may influence the situation of environmental industry as well. The regional environmental impacts of the environmental investments and developments in Budapest must be taken into consideration when making future development decisions, meeting this way the harmonisation requirements concerning the criteria of sustainable development.

Conclusions and recommendations

The analyses clearly demonstrate that the contribution of environmental investments to the creation of sustainability and liveability is irreplaceable. Looking at the satisfaction of the criteria stated in the sustainable urban development directives of the EU in the most advanced region of Hungary, i.e. capital city, we can see that now the present lack of adequate financial background, the lack of the approved budget jeopardising adequate management – which is unique in the history of Budapest – question the very basic opportunity of any move towards sustainability. It is true that the mapping of the local endowments, characteristics, and opportunities is indispensable for the creation of a sustainable urban development strategy, but the utilisation of these is impossible without working decision-making mechanisms and a financial background. The efforts to meet the sustainable urban development ideas of the European Union appear on the one hand in the *Environmental Programme of Budapest City (2007),* and in the *Integrated Urban Development Programme of Budapest City (2009),* on the other hand; however, the implementation in practice is blocked by the problematic – in the present case non-operating – decision-making process.

The importance of investments in the environmental industry is not only emphasised by several experts and the present study but is also treated by the European Commission as topic of selected significance. For the integrated development of Budapest it is necessary to define the role, task and objective of environmental industry in sustainable urban development. The objectives set are shown by the *Sustainable Urban Development Index (SUDI)* featured in the study. The SUDI is suitable for the definition of the sustainability priority order of the projects to be implemented and it also assists the consideration of the synergy effects among the respective projects, which is indispensable for the complex and integrated evaluation.

Further recommendations include the necessity of non-environment specific developments and the focus on the environmental aspects in different other investments for the realisation of environmental sustainability. For the adequate assessment of the situation it is reasonable to take into consideration the regional environmental impacts of the environmental developments and investments implemented in Budapest on the whole region of Central Hungary. For the improvement of the developments with environmental objectives and the extension of the efficiency of implementation and social support it is advisable to establish a so-called *Environmental Industry Development Council* that is able to make decisions with the consideration of the synergy effects among the projects and the complex aspects of sustainable urban development.

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DEVELOPMENT OF THE ENVIRONMENTAL INDUSTRY AND RURAL AREAS BY PRODUCING AND UTILISING BIOENERGY FROM A SYSTEMATIC AND PRACTICAL APPROACH IN NORTHEASTERN HUNGARY [*]

János Nagy – Botond Sinóros-Szabó

Introduction

The alternative biomass production – which also affects the environmental industry – provides a broad opportunity to establish and implement complex development strategies in Hungary, more specifically in the so-called tri-border area which includes the micro-regions of Szabolcs-Szatmár-Bereg, Borsod-Abaúj-Zemplén and Hajdú-Bihar counties. Bioenergy production from biomass, the produced energy and its utilisation in the country and in the spatial environment represent the infrastructural-technological development of rural areas, the creation of new jobs and keeping old ones, strengthening of environmental harmony, reduction of environmental load and, as a surplus of all these, high level of innovation and strengthening social cohesion of the rural areas.

Biomass-bioenergy conversion conforms and organically adjusts to the development strategy of the European Union and to the solution of complex energetic problems which the whole world deals with. This study strives to arrange the scientific inherences of this topic into a system. It presents the potential bioenergy production from the rurally produced biomass and its effects on the increase of energy production and stability, job creation, technology and infrastructure development, the strengthening of environmental harmony, the reduction of environmental load and – as a summary of all these – the strengthening and growing social cohesion and innovation. Last, but not least, this study deals with the definition and analysis of the basic inherences and characteristic of a biomass fired power plant fit into a spatial environment and the practical implementation of scientific-theoretical basics and relations.

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[*] This study was made by using the results of the BIOENKRF Asbóth Oszkár R&D program supported by the National Office for Research and Technology (NKTH).

The importance and timeliness of the topic

During the last half century, the modernisation and change of technologies and technological systems increased beyond imagination. This tendency provides the society, economy and the natural and human environment with a new skill not existing before.

This new skill appeared in countless new forms; let us just think about the mobile phones communicating via radio waves, Internet, the changes in traffic, the conquering of space (after the Moon, we also research Mars) or the conversion (decoding) of energy "encoded" in vegetable and animal organic material in a way that it can be used in our existing and built up equipment and networks.

Nowadays, we can clearly see that the practical implementation of this new technological skill shortens the ways and it brings the expediently related and interconnecting areas and activities into a positive interaction in the area of society, economy, natural and human environment. All these plastically show that the especially high standard technology also provides new opportunities and responsibility. The main opportunity is to give answers to the existing and comprehensive big (and also urgent) questions. Responsibility is represented by the utilisation of our possibilities lying in our extremely high technological abilities and by the question whether we will be able to develop a new structure to answer the questions to be solved, even if they are inconsistent with the current solutions.

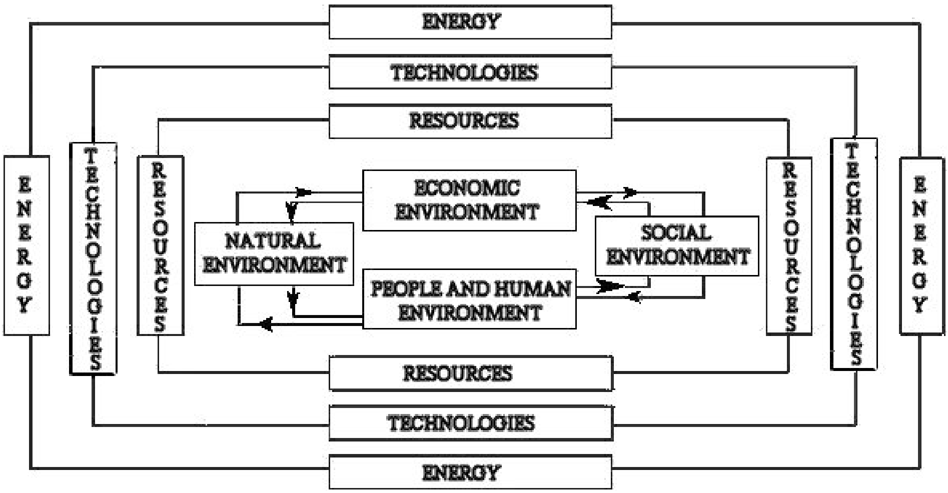
It is an unquestionable fact that one of the biggest problems in the world is energy supply, energy safety and energy harmony. As long as the traditionally used stock energies (fossil energy resources) dangerously decrease, the energy need increases and the loading of the already overloaded environment further increases. (According to the predictions, the energy need of Hungary is expected to increase by 1,800–2,500 MW performance capacity until 2020 in comparison with the current level.) Bioenergy produced from vegetable and animal biomass will contribute to the solution of the problems of energy supply, energy safety and energy harmony. One of its main consequences is the development of rural areas, the improvement of the quality of life, the end of migration and the decrease of the number of urban immigrants who have no roots.

Systematic approach of development

Our developments aimed at bioenergy production will appear in a stressed way in the period to come, as Hungary – also from the aspect of the European Union – is well supplied with vegetable biomass, therefore, it has a good ability to produce vegetable biomass. Developments and their practical implementation can only be explained if they are put into a system and its opportunities and restraints can only be defined in this system. Figure 1 shows the structure, connections and functioning of this system.

Figure 1.

Structure, functioning and connections of the energy-focused system



Source: by the authors.

The centre of the system presented in Figure 1 is determined by the interactions of natural environment, society, economy and human environment. The functioning (conditions of existence) of all these is determined by the quantity, quality and service ability of resources. In the system of resources, natural resources (soil, water, air, solar energy, climate) call for special attention, with special regard to their negative tendencies. It can be established as a fact that the quality and service ability of natural resources is continuously deteriorating and their available quantity is decreasing.

It is an essential concept that we use technologies and technological systems to convert resources to products. The connection between technology and product constitutes an inseparable unity and it is the practical manifestation of the interactions between nature, society, economy, people, their human environment and resources.

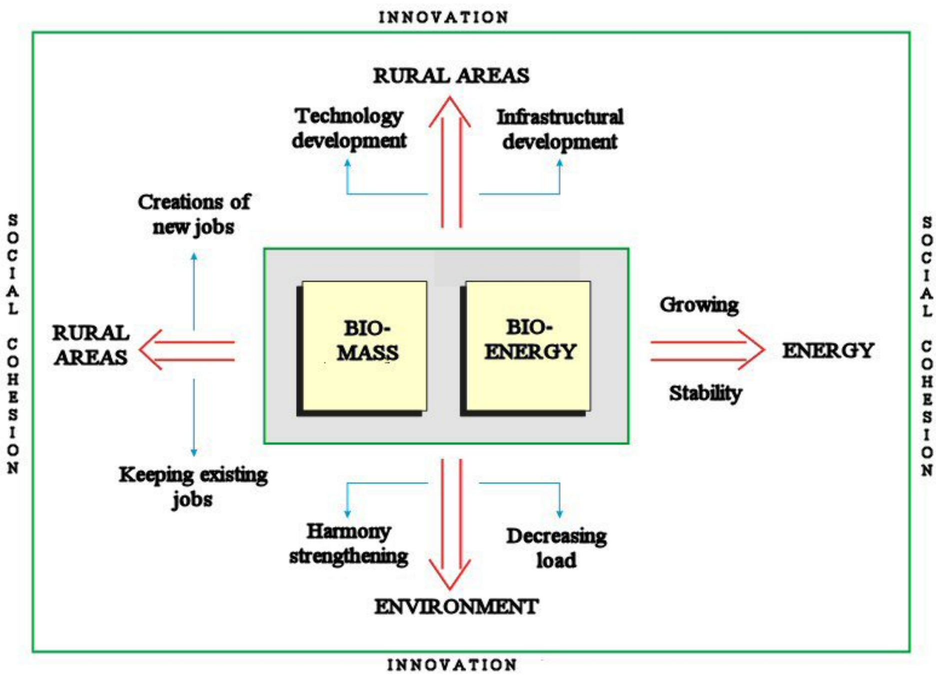
The basis and vital condition of the energy-focused functioning of the world is the energy which determines life. All this has a dual nature. On one hand, it is the condition of the existence of the world's functioning, whereas it is an indispensable product of the functioning of economy. This dual character of energy, the limited quantity of stock (fossil) energies and its decreasing tendency calls for the operation of an energy source which brings the production and utilisation of bioenergies to the front.

System of biomass energy conversion

We wish to bring scientific-theoretical bases and the strategies related to them closer, so that they can be implemented in practice. In order to do this, we define the heat conversion, heat utilisation characters and relations of arboreals and non-arboreals, as well as burnable organic matters from a practical aspect. Before the practical details, we have to shed light upon the systematic basic connections, as the practical details have to fit into this system. On Figure 2, we present the determinant elements and connections of the basic relations of bioenergy production from biomass.

Figure 2

The complex development strategy of biomass-bioenergy conversion



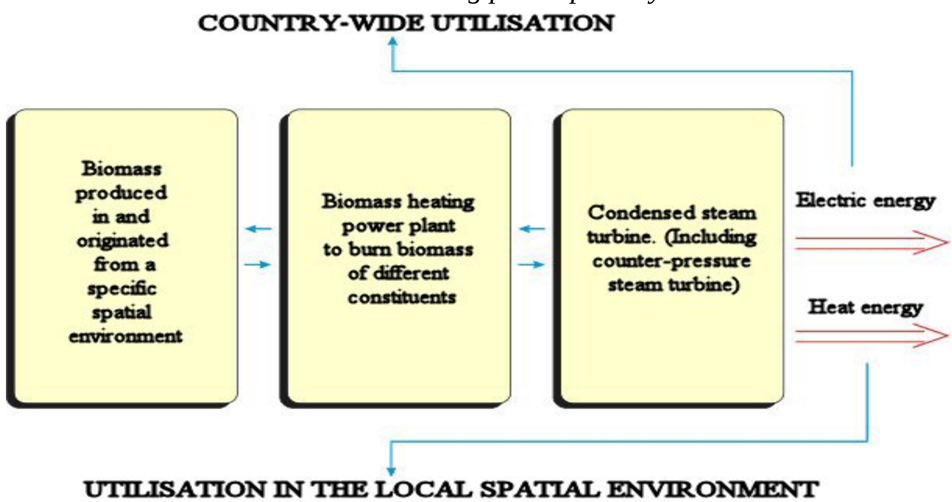
Source: by the authors.

On one hand, bioenergy produced from biomass – by the produced heat and electric energy products – strengthens and stabilizes growing processes and it has a positive effect on human environment by helping to keep existing jobs and creating new ones, on the other hand. Bioenergy production needs high standard technological development and "top" quality infrastructure. Bioenergy production from biomass fits into the harmony of natural-environmental development, strengthening it while reducing environmental loads (mainly CO_2 emission). All these together have a favourable effect on the strengthening of innovation processes.

It comes from the scientific substantiation and the approach arising from it that bioenergy production technologies fitting into the given biomass spatial environment, based on the biomass varieties produced in the given spatial environment must be adapted, their size have to be determined, effectiveness analyses have to be done and their logistic system needs to be worked out. This system is shown by Figure 3 from the aspect of a biomass fired power plant. The electric energy and heat energy produced from biomass will be utilised in the country and the local spatial environment. The unique and common features of the two forms of energy utilisation have to be taken into consideration and the logistics needed to it has to be developed.

Figure 3

The biomass heating power plant system



Source: by the authors.

Biomass feedstock

The produced, grown and available vegetable biomass and organic matter is in an inseparable connection with the performance (size) and technological structure of the biomass fired plant and its connected turbine. The big weight and the moderate logistic costs justify a transport from a spatial environment which has 20–30 km long radius when train transport is used (the distance can increase in the case of train transport). Biomass harvesting is seasonal, whereas the operation of biomass fired power plant is continuous, therefore, the transport of biomass heating material, their placement in temporary and daily storage places, manipulation, feeding them into biomass fired plants and their preparation calls for the planning and implementation of a synchronised, complex logistic task.

The economic industrial-sized heating power plants belong to the 30–100 MW electric performance category and they mainly have a huge biomass feedstock need – the evaluation analyses the sizes falling into the 50–100 MW electric performance categories. In order to have systematic and moderate transport and logistic costs and not to exceed 20–30 km transport distances, it is needed to build on the manifold biomass feedstock of the given biomass spatial environment during the operation of the biomass fired power plant.

Major biomass organic material groups:

I. Agricultural by-products.
II. Forestry by-products.
III. Arboreal energy plantations.
IV. Non-arboreal energy plantations.
V. Burnable waste base (organic matter in communal waste, by-products of biodiesel production, biogas sludge, compost, sewage-sludge compost, selective used wood material, certain paper types, maize, sunflower stalk, straw etc.).

Specific background analyses deal with the detailed burning technology characterisation of biomass organic matter groups. Of these, it is worth emphasising the energetic features of certain burnable products (*Table 1*).

Table 1

Main energetic features of fuels

Fuels	Specific quantity (t hect.$^{-1}$ year^{-1})	Heating value (kJ kg^{-1})	Moisture content (vol %)	Specific energy indexes		
				GJ t^{-1}	GJ ha^{-1}	kWh hect $^{-1}$
Agricultural by-products	6	12,000–13,000	9–12	12	72	2,000
Forestry by-products	13	11,800–12,200	27–30	14	42	1,167
Arboreal plantation	15	12,700–13,700	29–32	14	210	5,833
Non-arboreal plantation	20	14,600–15,500	7–9	15	300	8,333

Source: by the authors.

It is also worth considering the organic matter selected from communal waste, with special regard to the fact that there will be a regional waste storage facility of 60,000 t hectare^{-1} capacity built in the vicinity of Nagyecsed. The volume ratio of organic matter in waste is between 45–55%, whereas its weight ratio (due to the small density) is between 6–14%. The specific heat of the organic matter in communal waste is low (7–9 MJ kg^{-1}), but a rather burnable energy mix compost can be produced if we mix it up with glycerine (biodiesel), dry lognocellulose, sunflower and maize stalk, therefore its specific heat will significantly increase (14–16 MJ kg^{-1}).

The main features of biomass fired power plant and bioenergy conversion

Yearly operating hours: 8,000. Utilised operating hours: 85–95%. Efficiency of bioenergy conversion: 28–35%. Based on the given characters, the yearly actual electric energy production of biomass fired power plant that has 100 MW electric performance is between 680–760 million kWh. The energy content of the biomass fuel fed with burning purposes is between 2,190–2,450 million kWh. The yearly quantity of the fuel to be transported into the biomass heating power plant is 650–750 thousand tons.

The sizes of the biomass fired power plant

The collection, origination, production of biomass fuel and the safety of the energy production of biomass fired power plant rationalises the fact that a *biomass fired power plant of 100 MW should form its total electric performance using 2 units of 25 MW performance and one unit of 50 MW performance*.

This breakdown of performance makes it possible to use serial and parallel operation and the fact that systems with 25, 50, 75 and 100 MW performance can operate. The separated operation of each unit makes it possible to classify biomass fuels into fuel unit. As a summary of the things written above, the *ingredient* ratios of the total fuel need of the biomass fired power plant are the following.

I. Agricultural by-products 15–18%
II. Forestry by-products 15–18%
III. Arboreal energy plantation.................................. 22–25%
IV. Non-arboreal biomass 25–30%
V. Waste material... 9–15%

Waste burning – if there is enough quantity available – can also be *planned to have higher proportion* than indicated (20–25%). Burning is always subject to permission of environmental authorities. The organic material extracted from communal waste – based on the prescription of the National Public Health and Medical Officer Service – go through a basic treatment, following which they will be ready for preparation and authorisation to burn. (Vet. paragraph 3.8, point 4, and 389/2007. (XII.23.) Govt. regulation)

Technological questions of biomass fired power plant

Due to practical and safety reasons, the biomass fired power plant needs to be put together from three units (2 units of 25 MW and one unit of 50 MW performance). In order to increase the efficiency and economicalness of the favourable cycle process, heat production and utilisation also have to be ensured besides electric energy production. Due to the safety of the common favourable thermal cycle process and the increase of efficiency, a steam turbine which has a steam uptake adjusted to the heat demands has to be provided. Our detailed background analyses totally support this concept.

The technological implementation and burning technology of biomass fired power plant has to be developed in a way that it should not exceed the emission values specified in the Govt. regulation no. 23/2001. (XI.13.) referring to solid material, carbon monoxide, nitrogen oxides, sulphur dioxide and organic carbon compounds. (All these are sufficiently detailed in the background analyses. Also, we will describe implemented Hungarian and European examples.) As for acquisition, companies MAN and Alstom will be preferred.

The background analyses available describe the structure of the biomass fired plant and steam system, its possible implementation, structure of the steam turbine, auxiliary equipment, cooling system, biomass fuel varieties and their effect on harmful material production and also issues of wastewater management. The main characteristics of steam turbine and biomass heating power plant in reference to the electric performance of 50–100 MW are as described in Table 2.

Investment cost

The investment cost of the biomass fired power plant includes the costs of the biomass fired plant, the steam turbine, the generator and condenser. Its specific value is between 600,000–750,000 HUF per kWe. This means that the investment cost of a biomass fired power plant of 50 MW electric performance is 30–37.5 billion HUF. The same cost is around 60–75 billion HUF in the case of 100 MW electric performance. We verified the investment cost data in our background analyses by Swiss and German practical examples, and we found them appropriate and similar to foreign data.

Table 2.

The main features of steam turbine and biomass fired power plant

Condensing performance, no uptake*	MW	50	100
Heat consumption	t h^{-1}	132.8	263
Performance of counter-pressure steam turbine**	MW	26.4	52–53
Biomass fuel consumption	th. t $year^{-1}$	340–380	650–750
Investment cost of steam turbine	MEUR	18–20	35–39
Investment cost of condensing equipment	MEUR	4–4.5	5–5.5
Waste heat of counter-pressure steam turbine	MW	95	189
Total length with generator	M	32	36
Width	M	16	20
Total weight with generator	tons	160	200
Space demand (total, biomass heating power plant)	hectares	11–14	24–30
Those providing information in Hungary	ERBE,Siemens Zrt.,Siemens Power plant		
Possible producers	Skoda, Siemens, Brown-Boweri		
Heat utilisation			
Heatable horticultural plant	hectares	46–31	92–62
Heatable fish-breeding pond	m^2	200,000	400,000
Heatable houses	m^2	370,400	740,800
Heatable storage house	m^2	926,000	1,852,000

Notes: * Fresh steam temperature/pressure. 540 °C/100 bar; Condensing temperature/ pressure: 25 °C/0,0328 bar; Efficiency of the total condensing steam turbine. $\eta_{izT\ kond.}$ = 0,91 ** Heat uptake in accordance with steam demands is planned at a pressure level of 4 bars.

Source: by the authors.

Aspects of economicalness

One of the basic questions of the economical operation of biomass fired power plant is being prepared to unexpected situations and appropriate operation even in these cases. Concerning this issue, we have to be prepared for the planned, continuous provision of biomass fuel (e.g. problems in transport, weather difficulties during the winter, etc.). Besides the storage facilities designed for cases like this, a coal stock can also be planned (to a 5-10% part). The income of the heating power plant comes from four sources:

1. Electricity production – sale
2. Heat production – sale
3. Reducing CO_2 emission – sale
4. Income of environmental protection services (by waste burning)

Sources of income and profit need to be planned in a complex and detailed way. The long-term provision of biomass fuels is also part of this issue. In order to be able to implement this in practice, it is worth entering into long-term guarantee agreements with biomass feedstock producers. One form of this is to have biomass feedstock producers among the founders of the company operating the biomass heating power plant.

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REGIONAL DEVELOPMENT IMPACTS OF THE USE OF WASTE HEAT OF AN ENVIRONMENT FRIENDLY COMBINED CYCLE POWER PLANT IN THE NORTH GREAT PLAIN REGION*

Béla Baranyi

Introduction

The strengthening of the regional role of environmental industry may be promoted by a large-scale investment of the near future planned in *Nyírtass*, a settlement of Szabolcs-Szatmár-Bereg county, in the corner of the so-called triple border region along the borders of Hungary to Slovakia, the Ukraine and Romania. In this micro-region that is a less favoured area of Hungary – in fact, an area of multiple handicaps –, a combined cycle power plant is planned whose waste heat could be used by greenhouses, dryers and heated water fish cultures. These establishments and the other developments for the processing and storing of their primary products, together with the other logistics developments, can generate considerable regional socio-economic effects in the narrow and broader environment of the investment. The economic development impacts will have a strong impact on development and reindustrialisation especially in the *Baktalórántháza micro-region*, but its effects will also be palpable in Szabolcs-Szatmár-Bereg county, in fact, the whole of the region of North Great Plain.

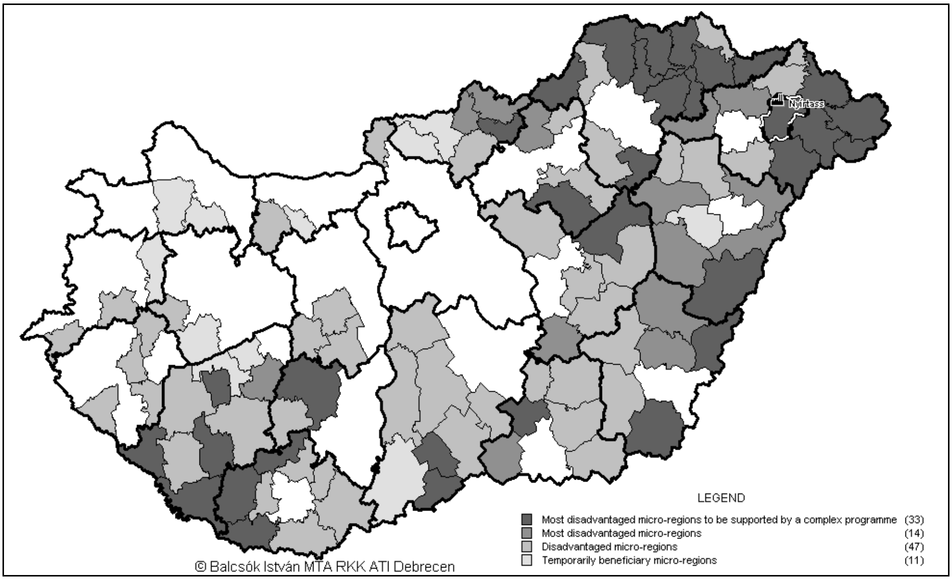
Every investment in this industrially underdeveloped micro-region – in this case the development of environmental industry – is of outstanding importance, as not only the Baktalórántháza micro-region but also the neighbouring micro-regions of Ibrány-Nagyhalász, Mátészalka and Vásárosnamény are among the most disadvantaged micro-regions in accordance with the Government Decree No. 311/2007 (17 November) – what is more, the latter three are among those that are to be developed with complex programmes, i.e. are among the least developed micro-

* The study was made in the framework of the so-called BIOENKRF (2006–2009) research programme called *Establishment of a Bioenergetics Innovation Cluster and Implementation of R & D Programmes in the field of the use of biomass*, at the Debrecen Department of the Centre for Regional Studies, Hungarian Academy of Sciences, led by Béla Baranyi, Doctor of the HAS.

regions of Hungary –, so the whole of the area lags far behind the national average from economic, social and infrastructure aspects (*Figure 1*).

Figure 1.

Disadvantaged and most disadvantaged micro-regions and settlements in Hungary, 2007

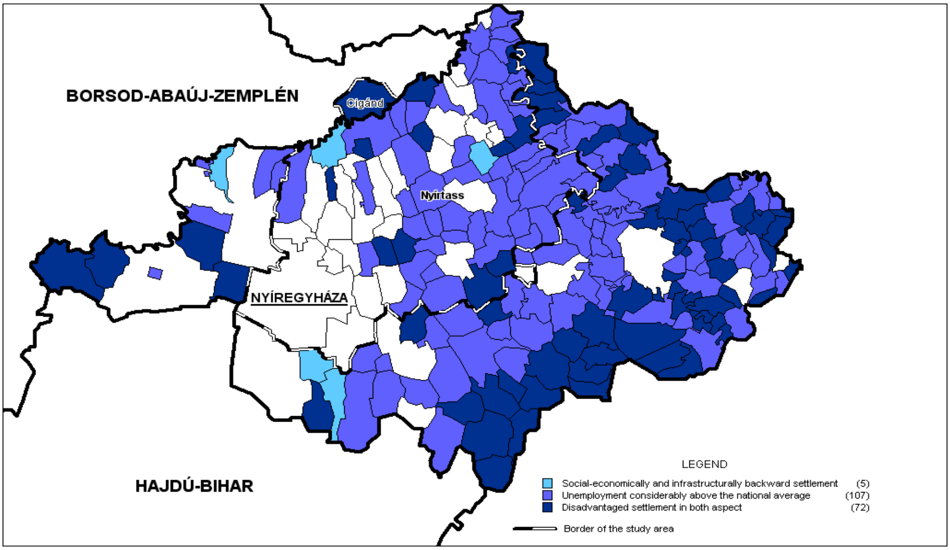


Source: by the Debrecen Department of the CRS of HAS, based on the Government Decree No. 311/2007 (17 November).

Within Szabolcs-Szatmár-Bereg county, a county situated in the north-eastern part of Hungary, not one of the micro-regions of Nyíregyháza, Kisvárda, Nagykálló and Záhony are among the micro-regions with the least favourable indices, still they are among those 47 micro-regions that are eligible for special spatial development supports due to their "disadvantaged" situation (practically the whole of Szabolcs-Szatmár-Bereg county is in this category, with the exception of the county seat and the settlements in its direct neighbourhood). The micro-regions of Baktalórántháza, Vásárosnamény and Mátészalka are among the thirty micro-regions in the worst positions in the rank of the 174 micro-regions of Hungary by their complex socio-economic development indices. At the planning and implementation of any development concept targeting the reindustrialisation of this area thus has to consider that the model region locating the combined cycle power plant is in an area belonging to the *47 most disadvantaged* micro-regions of Hungary – among these micro-regions we find the micro-region of Baktalórántháza and seven more micro-regions from Szabolcs-Szatmár-Bereg county –, so all investments employing a large number of labour force and promoting the diversification of the local economic structure is of selected importance (*Figure 2*).

Figure 2.

Disadvantaged micro-regions of spatial development, 2006



Source: by the Debrecen Department of the CRS of HAS, based on the Government Decree No. 240/2006. (30 November).

The combined cycle power plant with 2,400 MW nominal capacity, starting its operation after the developments in *Nyírtass*, and the connected further developments – in addition to the significant enlargement of the energy supply capacity of Hungary – means *job creation for approximately 2,000 people*, offering a broad range of jobs with different qualification requirements. The significance of the investment is indicated by the fact that the number of newly created workplaces exceeds the total number of employment in Záhony. In addition, the utilisation of the waste heat increases the efficiency of the power plant, agricultural producers will have an access to cheap thermal energy and the environmental burden caused by the establishment is decreased. The volume and innovative character of the investment makes the power plant unique not only in the direct region but also in the whole of Central Europe, so its competitiveness seems to be secured in the long run, due to the predictability and security of the production.

Besides the adaptation and generation of innovations, the power plant complex will have an extended network of suppliers and relations by which it will play a role in the penetration of new technologies, methods and tools in the region. The energy produced in the power plant and the production of the high-level horticulture establishments built on this energy will both decrease the import dependence of Hungary and lead to the opening of new export markets.

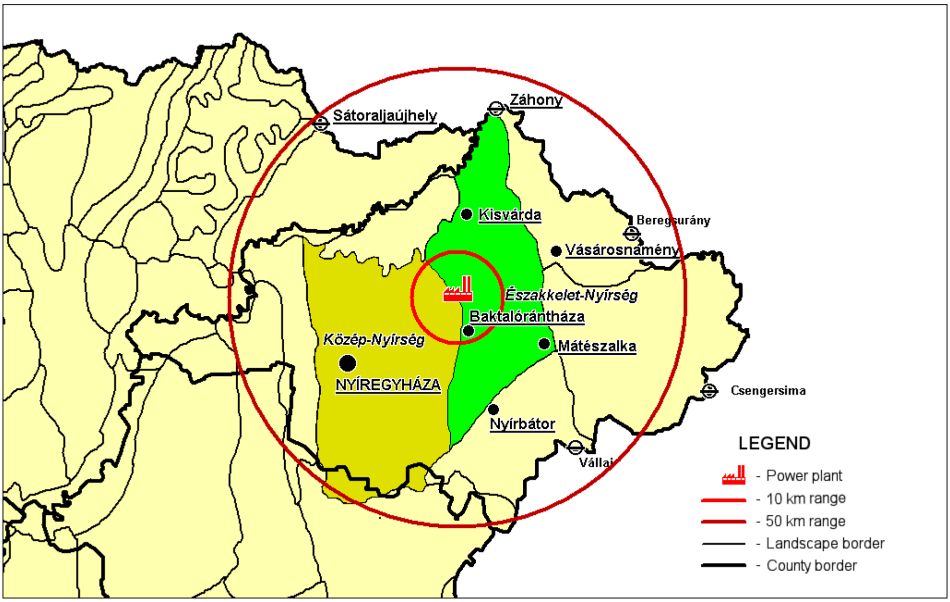
Impact area and spatial structural dimensions of the investment

Multi-level impact area

Coming from the size and diversity of the investment, several spatial impacts of varied intensity are expected. The most extended impacts may be felt in a circle of approximately 250 kilometres from the power plant, within which the products manufactured may have a strong market-shaping effect. The boundary of the widest area of action in Hungary is thus Budapest, in northern and eastern direction this area reaches beyond the state border, to East Slovakia, Transcarpathia and Northwest Transylvania. The most intensive relations will of course be made in the direct environment of the power plant, the production district can be built out within a circle of 10 kilometres, in the territory of 8–10 villages (*Figure 3*).

Figure 3.

Boundaries of the production and logistic district of the power plant complex



Source: Debrecen Department of the Great Plain Research Institute, CRS of HAS.

Logistics tasks can be organised in an area within a 50 km radius, which covers almost the whole of Szabolcs-Szatmár-Bereg county, due to the location of the power plant in the proximity of the geometric centre of the county. The varied transport geographical endowments may considerably modify the extent of the area of impact; it may stretch and expand along the main transport routes, while in less accessible areas the investment will probably have fewer positive impacts. In addition, due to the relations towards Slovakia, the Bodrogköz area – also a disadvantaged area – may be affected, together with Sátoraljaújhely, while the city of Debrecen will be a dominant factor of the spatial structure because of its airport and training and R & D basis. Having all this in mind, an important prerequisite of the investment is the mapping of the regional characteristics of the consumption market in the catchment area of the investment, and the definition of the logistics junctions most optimal for sales, calculated with the time and cost factors.

Impacts developing transport infrastructure

In the direct vicinity of the planned investment there is a very important transport corridor which is part of the Trans-European Network. Road and rail access is very important in the creation of the adequate logistics system. The location of the investment is a spot between main road No. 4., the major transport axis of the region and road No. 41. running from Nyíregyháza via Vásárosnamény to Beregovo in Transcarpathia. A promising sign for the future is that the extension of the Hungarian motorway network reaches the micro-region, and the newly constructed motorway may divert a considerable part of the traffic from the present road network, especially from the already overloaded road 41. After the construction of the new section of motorway M3 between Nyíregyháza and the Ukrainian border the micro-region of Baktalórántháza will have motorway; the construction should be completed until 2015 according to the latest plans. The section of the M3 built as a speedway will bifurcate after Vásárosnamény, and the two branches will reach the Hungarian–Ukrainian border at the Barabás village and Záhony town.

The connections to the Szatmár areas and Romania will be provided, according to the plans, by the speedway M49 to be built between Mátészalka and Csenger. Although the planned speedways will be a considerable progress for the accessibility of the micro-region and its system of regional relations, and will also alleviate the implementation of the logistics tasks necessary for the operation of the power plant, they cannot substitute in themselves the reconstruction and development of lower rank roads, especially in the direct vicinity of the investment. In addition, of course, it will be necessary to have roads that divert the growing traffic from the inner areas of the settlements.

Another important logistics task is the transport of the labour force of the power plant that can be solved by the introduction of bus lines run by the company operating the power plant.

Railway must have a significant role in the movement of the considerable amount of agricultural raw materials, as it offers a much more environment friendly solution than road transportation. This can be done by the construction of an industrial railway connected to the main line No. 100 linking Záhony to Nyíregyháza and Debrecen, the dominant rail axis of the region. Although it is a line of smaller capacity, the single-rail non-electrified line No. 116 between Nyíregyháza and Vásárosnamény – located south of the power plant complex, touching Baktalórántháza – should be taken into consideration as an alternative solution. This way the logistics functions of the micro-regions of Baktalórántháza and Vásárosnamény would strengthen. In order to achieve this it is important to examine the intensity of use of the present transport network and the possibility to build access roads to the power plant, on the basis of available traffic data, the information concerning the quality of the roads and the transport development concepts.

Natural, social and economic conditions of the investment

Natural endowments

The planned project will be implemented at the meeting point of two physical geographical units, the Middle Nyírség and the Northeast Nyírség. It is an alluvial plain area covered mostly with sand and loess, with low elevations. As regards its climate, it is an area where moderately warm and moderately cool climate types encounter; looking at the precipitation conditions, it is moderately dry. The dominant type of soil is clay-filled brown forest soil; smaller areas are covered with humus-filled sand, wind-blown sand, brown forest soil and meadow chernozem. In a significant part of the physical geographical units subsoil water can be found rather deep, in some places more than six metres below the ground, subsoil water level is only high in the pits among the sand dunes. In areas covered with brown forest soils and chernozem plough lands are typical, spotted with orchards.

Traditional crops of the micro-regions are rye, potato and tobacco, but none of these produce high yields, due to the less favourable soil conditions. It is just the risk factors coming from the bad natural endowments that can be considerably decreased by man-made and operated greenhouse cultures. This way a significant amount of goods can be produced in a small area, irrespective of the weather conditions, which allows the removal of the low quality arable lands from cultivation and their use for e.g. bioenergetics purposes. The volume of greenhouse production will exceed by far the production volume of greenhouse farming around Szentes in the South Great Plain region (presently in leading position). This way the micro-region, with otherwise unfavourable agro-ecological potential can be in the cutting edge of the Hungarian horticulture. In the vicinity of the location of the planned investment there are no protected natural areas. Nevertheless the detailed and exact assessment of the agro-ecological potential of the area and the mapping of the environmentally sensitive areas are tasks to be done.

Characteristics of the labour market

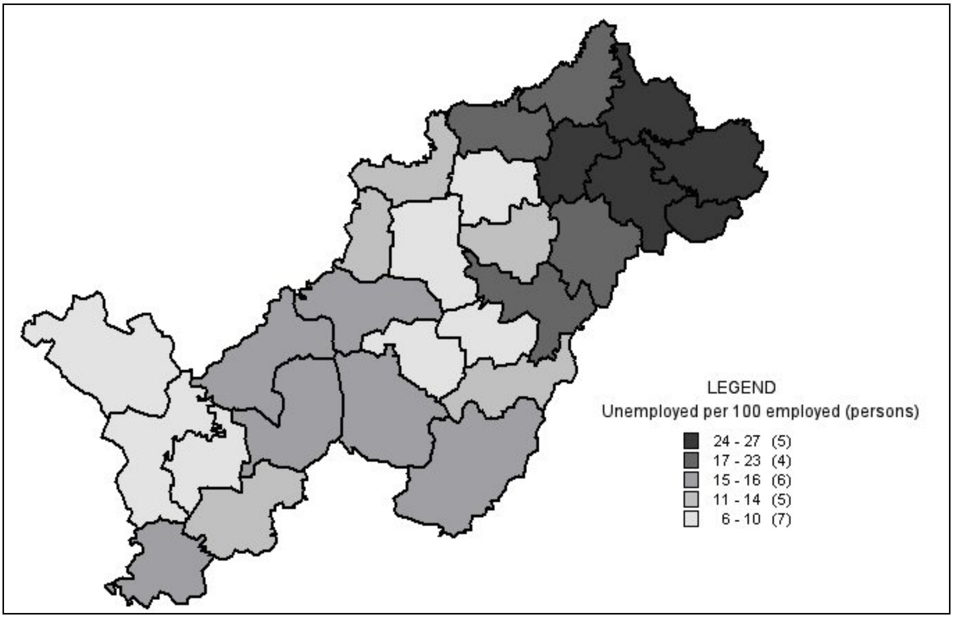
The *labour market problems* much more serious than the average have impact on the everyday lives of the total population of both the micro-region and the larger region (*Figure 4*). Szabolcs-Szatmár-Bereg county and the whole of the northeast Hungarian region have traditionally been areas with surplus labour, which is attributable, among other factors, to the typically small number of local jobs during the course of history. Although during the socialist decades the decentralised industrialisation created several industrial plants, the majority of these were soon liquidated during the recession following the political and economic systemic change.

The strong economic decline typical in the first half of the 1990s resulted in East Hungary, including the northern half of the Trans-Tisza region, in serious discrepancies between the demand and the supply side of the labour market, problems that are still palpable today. One of the signs of these problems was the *very serious decline in the employment rate*, and the parallel *very rapid increase in the unemployment rate*. The traditionally underdeveloped rural areas with a shortage of jobs and a surplus of labour were unable to employ the labour force flowing back from the nearby and distant towns and cities, and the labour market situation became critical in several micro-regions.

In employment the spatial disparities within Hungary stiffened, with some slight changes, and practically no palpable change occurred in the positions of the regions relative to each other. In fact, a process very unfavourable for the regional labour market started and accelerated after the systemic change: the number and proportion of economically inactive population increased substantially. In addition, besides the high proportion of health-related disabilities, the level of schooling of the population is low, there is discrimination and other negative phenomena in the area; as a result of all these factors the significant share of the Roma population – whose proportion from the total number of inhabitant of the region is far above the national average – lost all their connections to primary labour market and became inactive earners or passive unemployed.

Figure 4.

Number of job seekers per 100 employees in the micro-regions of the North Great Plain region, 2006



Source: Edited at the Debrecen Department of Great Plain Research Institute, CRS of HAS, on the basis of the joint database of the Hungarian Central Statistical Office and the Public Employment Service.

For the labour intensive harvesting, plant cultivation and goods transport activities that can be done by the most elementary education, in addition to the locally available labour market, there is cheap labour from the other side of the border, mainly from Romania and the Ukraine. For providing labour for the seasonal horticultural works, the adaptation of the legal methods applied in the EU countries can legalise the employment of cross-border labour, for which there are also national "green box" supports. Also, the unskilled labour or those with various levels of schooling from the neighbouring Borsod-Abaúj-Zemplén county are potential sources of labour. The agricultural works mentioned above can be taught easily, and the necessary skills are given at those responsible for the professional management. This means that the employment of labour force coming from other economic sectors cannot be a problem. However, a problem to be solved for the enlargement of employment is the mapping of the number and education level of the potential labour force; other tasks to be done include the survey of the opinions of the local agricultural entrepreneurs about the potentially available labour force, and the assessment of the habits and expectations of the local inhabitant concerning employment and their employees skills.

Training and technology background

The higher education institution of the region of North Great Plain, especially the Centre for Agricultural and Technical Studies of the University of Debrecen and the Faculty of Technical and Agricultural Sciences of the College of Nyíregyháza are a suitable basis for the satisfaction of the emerging R & D & I needs. There are already researches in the fields of plant production technology and mechanical engineering issues related to the investment, which are based to a large extent on the findings of international research programmes and the surveys carried out by foreign partner institutes. An important aspect is the support and the creation of the professional institutional basis for the harmonisation of practice with research and development and consultancy, the background for which is provided by the Research Development Institute working in Debrecen. In Szabolcs-Szatmár-Bereg county there are two institutions engaged with *secondary level vocational training*: the Baross László Secondary and Vocational School of Agriculture (in Mátészalka) and the Bessenyei György School of Agriculture and Student Hostel (in Tiszabercel). In addition, the trainings in the Balásházy János Vocational School of Agriculture in Debrecen have several decades of tradition.

The problem-free operation of the power plant requires the presence of a highly organised *logistics network*, which has implications for training of course. In the supply of trainings in the region there are already trainings and further trainings of logistics character, and they have become popular and marketable in the recent years. Prerequisites for the provision of human resources suitable for meeting the new challenges, above all the qualified labour force with special skills, are the assessment of the skills needed for the investment of the students in the educational institutions of the region, and the mapping of the presence and the deficiency of the skills related to the special activities of the operation of the power plant. This can be supplemented by an opinion survey of the teachers of the educational institutions of the region about the investment as the place of practical training, about the skills and preparedness of their students and last about the amendments of the syllabus of the trainings to meet the new market demands. In addition, the assessment of the foreign professional relations of the training institutions and the possibilities of their expansion in the future must be done.

Structure of the businesses

One of the most important reasons for the employment and unemployment figures much worse than the national average is the economic structure which is unfavourable from several aspects not only in the micro-region but the whole of the region of the North Great Plain. The unfavourable endowments are reflected both in the number and the sectoral breakdown of the businesses, and also in the general shortage of capital basically influencing employment capacities, and the technology disadvantage coming from the shortage of capital.

Looking at the breakdown of enterprises according to the sectors of the economy, we can see that agriculture plays a much more important role than in the average of the country as a whole; the proportion of businesses in industry and construction industry is around the national average, while services sector, generally considered as the engine of the modern economy, is considerably underrepresented. The above average share of agriculture is evidently the consequence of the plain land character of the county and the favourable natural endowments coming from the climatic conditions, but the weight of this sector with an uncertain future and a generally low level of profitability in itself draws attention to the unfavourable local economic structure. This is also proved by the high number of private enterprises operated for want of anything better in the region; the proportion of such businesses in the region is much higher than the average: the national mean value is 58.8%, while it reaches 65.3% in the county and the region as a whole.

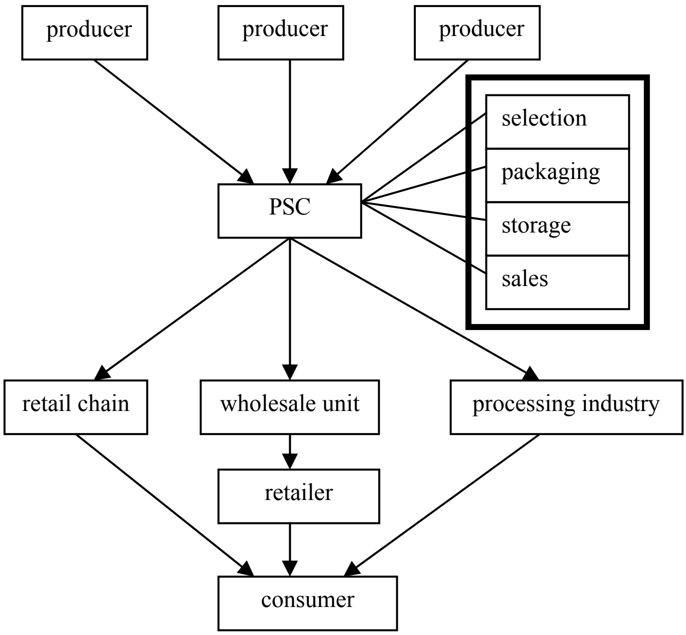
The creation of a business structure optimal for the implementation of the environmental investments requires among other things the survey of the opinion of the local agricultural entrepreneurs about the Production and Sales Cooperative (hereinafter: PSC) to be established in relation to the power plant. The successful operation of the power plant furthermore requires the establishment of an information centre for the producers and the organisation of institutional tasks which supply the local producers and the population with important information and advice of public use and of professional character about the issues concerning the investment.

Transformation of the ownership patterns

The *land demand of greenhouse horticulture* can be solved by land purchase or land leasing. Leasing, however, hides several potential dangers, because the investments require very large amounts of capital, consequently an eventual termination or the non-extension of a contract may result in substantial financial loss. In addition, the relocation of greenhouses is problematic, on the one hand because they receive energy from the power plant, and a significant loss of markets can be the consequence of the suspension of production, on the other hand. It is more advantageous then to purchase the land, but buyers have to know that the laws in effect regulating land purchase only allow a Hungarian citizen to buy land up to 300 hectares and a value of 6,000 golden crowns, and legal entities or economic companies are not allowed to buy land at all. What seems to be a favourable solution is to make the present owners of the land interested in the investments and possibly to include then into the production.

Figure 5.

Draft structure of the operation of the PSC



Source: by the author, after Erdész–Padisák.

The establishment and operation of PSC preferred and supported by the *European Union* as well could also improve the market competitiveness of the goods produced. According to the decree of the Council of Europe in 2004 it is necessary to reinforce integration within horticulture (PSC-s and producers' groups), by the support of the construction of logistics centres, cooling and packaging units, processing and sales (auction) halls implemented in the management of these integrations and the modernisation of the vegetable and fruit drying devices. It is important to have in mind that the Council of Europe does not support individual producers within the horticulture sector, only PSC-s or producers' groups. The role of the PSC-s established as an effect of the investment may reach beyond the production and sales of the respective goods, because it improves the competitiveness of the whole sector by the integration of the vegetable and fruit producers of the region (*Figure 5*).

It is also worth considering the modern production technologies using stone wool. Although the investment costs may be higher than in the case of traditional technology, the yields may be many times more than in the traditional technology (28 thousand seedlings per hectare). As a result of this viable economic units can be established on smaller plots, the labour demand of the complex can be further increased, having a further positive impact on the labour market of the region. The strengthening of the favourable processes must be accompanied by the exact mapping of the land ownership structure, the analysis of the land market of the region and the collection of the experiences of the PCS-s, operating in the region for years now.

Logistics functions and tasks

Taking the Western European examples as a basis, the goods produced in greenhouses located as an effect of power plant investments can be exportable if transport is also developed, there are enough and large enough cold stores and a viable logistics centre is established. In the territory of Szabolcs-Szatmár-Bereg county there are several cold stores and insulated storage facilities already in operation, all of which have been established by the producing companies presently using them, but they only have extra capacity seasonally and thus storage hiring is not possible. In the latest logistics and storage databases we cannot find any building for sale of for long-term lease. The newly established storage facilities are built in junctions with the best transport endowments, both in the direct vicinity of the power plant complex and within the complex itself. The major logistics tasks necessary for the successful implementation of the environmental industry investment are as follows:

- An analysis of the location factors of cold stores and insulated storage facilities from a logistics view.
- Enumeration of the companies dealing with storage and contacting them, opinion survey of those involved in job storing and job cooling on the potential cooperation, and the enumeration of the capacities available.
- Assessment of the geographical location and accessibility of the operating storehouses, cold stores and cooling facilities.
- Regional breakdown of the consumer market, definition of the main directions of development and on the basis of this the designation of the optimal location of the logistics bases.

International relations

Cross-border relations

In the last decade and a half cross-border cooperations have become more and more intensive in all seven border regions of Hungary. One of the main objectives of the institutionalised relations and cooperation strategies between neighbour areas is economic development and the promotion of economic relations; however, resources are often not available for this purpose. The regions neighbour to Szabolcs-Szatmár-Bereg county are not competitors for the planned complex in the sectors of greenhouse plant cultivation, i.e. they can be consumption markets, suppliers and sources of seasonal labour if good quality and reasonable prices are offered by the Hungarian establishment.

During the planning of cross-border relations and cooperations we must take into consideration the regional characteristics that the project is implemented in an area surrounded by the three state borders – the Hungarian borders to the Ukraine, Romania and Slovakia –, where the presence of the borders is not only a disadvantage but can also be advantage, especially in the case of internal Schengen borders. A key issue of the development of cross-border relations can be among other things the 137 kilometre long Hungarian-Ukrainian state border, the total length of which is bordering Szabolcs-Szatmár-Bereg county. For the developments of environmental industry it is still important then to preserve and develop the former intensive and broad relations to Transcarpathia, especially because the natural gas fuelling the power plant of Nyírtass arrives from this direction and the region is also important for other cooperations in the fields of environment protection and water protection. When talking about the Hungarian-Ukrainian border we have to mention that this is also an eastern external border of the European Union, so it is of special importance for the economy, due to the rather different endowments of the two sides. The number one objective of the cooperations under preparation is the utilisation of this economic potential. The three major cities in Transcarpathia (Uzhgorod, Mukacevo and Beregovo) can be major potential markets.

As regards the cooperations towards Romania, close cooperations across the Hungarian-Romanian border have been established among the neighbouring four Hungarian and also four Romanian counties and their centres. Due to its geographical proximity, the county of Satu Mare in Romania can be the most important, which has already built out cooperations with Szabolcs-Szatmár-Bereg county, with special emphasis on the promotion of the relations among the businesses. When making the regional designation of the marketing activity, however, this is not the only county to be taken into consideration: we have to calculate with the whole of the Northwest Region of Romania, especially the rapidly developing big cities (Satu Mare, Oradea, Cluj Napoca and Baia Mare).

We cannot neglect the issues of the Hungarian-Slovak cross-border relations in this region, either. Although the territory of Szabolcs-Szatmár-Bereg county is bordering Slovakia in a no more than six kilometre section, and there is no border crossing station across this short border, the south-eastern part of the region of East Slovakia are within 50 kilometres from the location of the investment as the crow flies, and the centre of the Slovakian region, Košice is only 119 kilometres on road from the location of the power plant in Nyírtass, which is a 2 hour and 20 minute travel. Slovakia is already one of the main target areas of Hungarian vegetable export, and the natural endowments of East Slovakia are definitely unfavourable for horticulture, so it can be an important potential market.

Taking all this into consideration, during the sustainability – and development – of the cross-border relations a very important priority is the mapping of the market conditions and commercial networks in the neighbour countries, with special regard to the marketing of vegetables and fruits and the assessment of the possibilities in other cross-border cooperations.

Potential international relations

Regarding the globalisation and the European integration processes, the importance of greenhouse vegetable production, not sensitive to extreme weather conditions, is expected to increase. The two main species of vegetable produced in greenhouses are tomato and paprika, whose export potentials are quite different. The export-import balance of fresh paprika is very much positive for Hungary, the main export markets are *Germany*, *Austria* and the *Czech Republic*, while import – which is only a negligible part of the export – mainly comes from Spain, Morocco and the Netherlands. From the neighbour countries the main customers are Slovenia and Slovakia. The balance of the trade of fresh tomato is the opposite, even the export to the major markets (*Austria* and *Slovakia*) remains below 500 tons, while Hungary imported from Spain alone 6,000 tons of tomatoes in 2004, and also a quantity in excess of 1,000 tons from Italy.

On the vegetable market of European Union, among the main competitors of the Hungarian producers *Spain* has enormous capacities, but the quality of the Spanish products have frequently worsened due to plant protection problems; also, the average wages have considerably risen and the transport costs from Spain to the region of Central Europe are substantial. The Netherlands and Belgium are characterised, thank to the 50 years of continuous development, by an extremely developed technology, large production plants and high level of automation, as labour force is expensive and logistics costs are among the lowest in Europe. Eighty per cent of sales takes place in the super- any hypermarket chains. The countries of Southeast Europe (Bulgaria, Greece) and North Africa (Morocco, Egypt) are capable of vegetable growing at a relatively low cost level.

Besides the present energy prices, the winter vegetable growing in Hungary cannot be competitive with the Mediterranean region but the waste heat available from the combined cycle power plant can decrease the production costs, and the substantial costs of transport of goods from the Mediterranean region, and the better food safety conditions make this region of Hungary more competitive in vegetable growing. Markets for the fresh and more marketable goods can be, in addition the already traditional market of Germany and Austria, the neighbouring countries of Central Europe, where, following the example of Holland, the recently built retails chains could be targeted.

Another market that must be taken into consideration for the volume and efficiency of investments is *Russia*. It is well known that the significant part of the agricultural production of Szabolcs-Szatmár-Bereg county had been marketed on the eastern, mainly the Soviet markets before the systemic change, and the loss of these markets had a considerable role in the emerging and deepening of the crisis lasting for several years. The reappearance of solvent demand allows the regaining of some of the formerly lost markets, although with different products and better quality. A possibility for this is provided by the intention of the Moscow based food industry holding called "Ardex" to create a commercial and logistics centre in the vicinity of Moscow, on business grounds, definitely for Hungarian business circles, not exclusively but primarily for agricultural businesses. The concept of the project is about the creation of a large centre of 125 thousand m^2, including a rail and road destination, storage facilities, cooling capacity, exhibition space, customs office, meeting rooms and banking infrastructure. The hypermarkets of the large Russian cities can be a large market for the vegetables grown in greenhouses. Transport may be by air, using the regional airport of Debrecen.

An important professional, research and practical prerequisite of the development of international relations in any direction is the continuous monitoring of the international goods markets, collection of regular information on the costumers demand in the potential target countries of sales, and the monitoring of the international trends of customers habits.

Creation of product market lines

A basic problem concerning the sales of the products of vegetable growing is that packaging is usually below the quality of the product and is not attractive enough for the customers; and not last, marketing activity is often not efficient enough. In addition, the average-size farms in Hungary are unable to produce weekly transports, so it is much simpler for the supermarkets, the largest purchase markets, to buy goods from – often foreign – partners offering a large and reliable quantity. Considering the present amount of minimal wage in Hungary, an average family with four persons can have enough income from vegetable growing from an unheated area of 0.8–1 hectare. Such small size holdings, however, are unable to continuously produce and transport a large quantity of products week after week, i.e. they are incapable of providing a quantity of goods acceptable for a supermarket. At least for our five holdings of this size are needed for the production of a quantity that may be competitive from commercial aspect.

The goods produced can have better market positions if the production activity is accompanied by different *follow-up works*, *so-called post-harvest activities* in fruit and vegetable growing, including marketing activity, packaging, cooling, post-ripening, market organisation etc. The post-harvest facilities (storage, packaging), besides improving the market competitiveness of the product, are excellent practice locations for higher education students, promoting this way the modernisation of higher and vocational education by the emphasis on practical activities. For the efficiency of such works, it is necessary to discover the best practice facilities and production plants dealing with post-harvest activities, and contacting them for the collection of professional information. Further tasks to be done in this respect include the full survey of the knowledge of local farmers and entrepreneurs on the post-harvest activities and special works, and a thorough analysis of the demands of multinational supermarkets working in the catchment area of the investment concerning the fresh products. A closely related task to be done is the survey of the demands, expectations and preferences of the customers in the respective supermarkets and shopping centres.

Product protection and food safety

In the European Union the quality requirements concerning vegetables and fruits were standardised with the use of former standards and these new standards have been in use since 1996. The requirements were adapted by Hungary before its accession to the Union and they made parts of the Hungarian Food Code (Codex Alimentarius Hungaricus). After the accession these standards were taken out from the Food Code and are applied as separate EU decrees. The clear key word of the EU standards concerning the fresh goods market is *homogeneity*. These standards regulate in detail all requirements concerning the quality, appearance and packaging of the products. The multinational retail chains, with an ever increasing weight in trade, consider these standards as relevant. The relevance of the standards is of course extended to the other sales channels (e.g. small local market, wholesale market), but their consistent use is still not a general practice in these establishments.

A factor having a favourable impact on the investment in Nyírtass is that the trade of goods produced as products of green houses *using waste heat* is *not affected by the* European *quota system – with exception of industrial tomatoes* – so their production and marketing can be carried out without limitations. The production of several goods can be supported by intervention purchase, the vegetables for which intervention prices are valid are tomato (4.8 € cent per kilo), aubergine (3.9 cent/kilo), cauliflower (7.1 cent/kilo), water melon (4 cent/kilo) and melon (4 cent/kilo). Withdrawal is the competency of the PSC-s, private producers can only have intervention payments through the PSC-s. It is not worth offering the goods produced for intervention, as the price does not even cover the costs; in addition, the Western European markets have a large purchasing capacity, so the fruits and vegetables can be marketed with a reasonable profit.

The EU, in order to protect its own producers, does not only impose duty (5–20%) on the products from ex-EU countries but also defines an access price system for products produced in large quantity at certain times, i.e. extra duties have to be paid after the import goods cheaper than the access price. Access price is defined for the following vegetables: cardoon, zucchini, water melon, cauliflower, tomato, melon, aubergine and cucumber.

The prospects of the Nyírtass investment are improved by the fact that the *vegetable market is hardly regulated in the EU*, so there is a free and open competition in Hungary as a part of the integration. By the abolishment of duties the EU did not only become a huge single market but also a joint production area. It is typical of the whole Union that the proportion of exported and imported vegetables is growing year after year, which is also due to the unbelievable development of transport in the recent years. Today it is not a problem to transport tomatoes on road from Spain to Sweden or to Hungary on time. These factors brought a competitive advantage in vegetable growing for those countries and regions where the natural endowments are better for the respective vegetable and which are able to produce homogeneous and quality products in large amounts.

The products grown in the planned greenhouses can only have market of their own and compete with the largest European vegetable exporters (Spain, the Netherlands and Turkey) and the more and more rapidly developing exporters of North Africa, East Asia and South America if storage, packaging and transport are solved. In addition, it is of basic importance to carry out continuous innovation activity built on the local knowledge base, which increases the amount of products grown and decreases production costs. The increase of the yields is possible by the use of up-to-date technologies; the introduction of these is evidently costly but in the long run the investments can double the innovation potential of the region. The positions of the investments can be significantly improved by the working out of a quality control system applicable in practice for the production and storage of the given products, and by the continuous search for markets for the goods produced.

Summary

The experiences collected from the use of the waste heat of the combined cycle power plant in Nyírtass can be utilised for other investments. However, the impact mechanisms possibly induced by the investment, the diversity of the possible problems and the multi-level catchment area of the complex up to 250 kilometres all justify the necessity of further thorough academic researches, for both the concrete investment and any other development of similar character. Due to the complex impact mechanisms concerning spatial structure, economy – with emphasis on trade –, foreign relations (markets, suppliers etc.), local society and the environment, it is not only specific assessments before the investment that should be made but also a continuous monitoring in the medium and long run. The analyses thus lead to a more or less regularly updated data and document basis that allows the monitoring of the efficiency and the catchment area of the investment year by year, which would allow a more rapid reaction to the suddenly changing market conditions, on the one hand, and would also alleviate the further adaptation of the innovative technology, on the other hand.

For the development of environmental industry, the issue of the development of combined cycle power plants raises new challenges and tasks to be solved. One of these is that a growing environmental burden can be demonstrated by the tendencies of the latest period in Hungary in connection with the thermal water and natural gas heated plastic houses and glass greenhouses. This comes from the fact that many producers, due to the substantial rise in the energy prices, use traditional coal heated furnaces in the winter season. Because of the effort to reach a more cost efficient solution absolutely competitive against natural gas, however, the heating systems can only be partially automated, also, the amount of hazardous materials emitted to the air increase considerably at local level. Due to the global climate change and the improvement of the quality, the support of the substantial increase of production (of vegetables and ornamental plants) in covered places is manifested through co-financing in the development programmes.

Another important environmental aspect of the developments is that operational costs can be greatly reduced by the cheap energy, so the implementation of the investment based on economic interests can decrease the emission and concentration of flue gas hazardous for the environment and human health. The competitive advantage of thermal water heated greenhouses seems to be granted for a while, despite the auxiliary costs (water use fee, environmental fees, environment pollution fine, extra costs of pressing thermal water back into the aquifer etc.), but in medium and even more so in the long run the vegetable growing built on the waste heat of power plants can gradually utilise the advantages lying in the technology, besides the parallel decrease of the emission of the power plant itself. It is an issue of basic importance then to evaluate several factors when planning an investment of this type, enumerating the environmental burdens during operation, above all the potential sources of pollution. Last but not least, an important subjective prerequisite for the environmental industry developments is the expansion of the knowledge of the concerned population on the investment, the survey of their opinion and the dissemination of the information on the environment friendly character of the investment.

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THE ROLE OF SOLID BIOMASS IN THE RENEWAL OF ENERGETICS INDUSTRY IN THE REGION OF NORTH HUNGARY [*]

Gábor Koncz – István Balcsók

Deindustrialisation in North Hungary

The region of North Hungary has traditionally been known for its heavy industry. Mining and metallurgy based on the coal basins of Borsod and Nógrád and the ores mined in Upper Northern Hungary ("Felvidék", literally: Upper Country, the mountainous northern part of the Kingdom of Hungary) were dominant in the economy of the region for centuries. In the second half of the 20^{th} century, the region became a centre of heavy chemical industry and energetics as an effect of the industrialisation efforts. However, the sectors that were considered as "pull sectors" at that time soon became the losers of the economic restructuring in the western part of Europe, resulting in the birth of extended crisis regions in the traditional areas of heavy industry. The world-wide crisis of mining and metallurgy arrived at Hungary a few years later, in the years prior to the socio-economic systemic change and parallel to the loss of the Eastern markets. The crisis management that had also been a process for long years in Western Europe was rather lengthy in the heavy industry regions of Hungary, the effects of which are still very strong today.

The rapid collapse of the COMECON markets and the drastic fall in the domestic demand led to the breakdown of several large industrial plants (especially in the metal industry), and this was exacerbated in the rural eras by the prolonged crisis and disintegration of the large agricultural holdings and the closedown of their units doing side activities. The signs of crisis were very strong in Borsod-Abaúj-Zemplén and Nógrád counties, two counties where the proportion of the large-scale heavy industry employers was especially high. In Heves county the heavy industry

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[*] The study was made in the framework of the so-called BIOENKRF (2006–2009) research programme called *Establishment of a Bioenergetics Innovation Cluster and Implementation of R & D Programmes in the field of the use of biomass*, at the Debrecen Department of the Centre for Regional Studies, Hungarian Academy of Sciences, led by Béla Baranyi, Doctor of the HAS.

activities were less dominant, but food industry, stronger in this county than the regional average, was heavily hit by the decline of agriculture.

Exact information on the changes in the number of employment is only provided by the censuses. In the region of North Hungary, the decade between 1990 and 2001 saw a 30% decline in the number of employment. The fall of industrial employment exceeded 40%, and the pace of the decline of this sector was three times faster than the national average. The number of industrial employees was 146,078 persons in 2001, and the sector had a 37.3% share from employment, as opposed to a 44.7% proportion a decade earlier. In the micro-regions known for their heavy industry (Kazincbarcika, Miskolc, and Ózd) the decline exceeded 50%, just like in those micro-regions (Edelény, Szerencs, and Szikszó) from where a large number of employees commuted to the industrial centres.

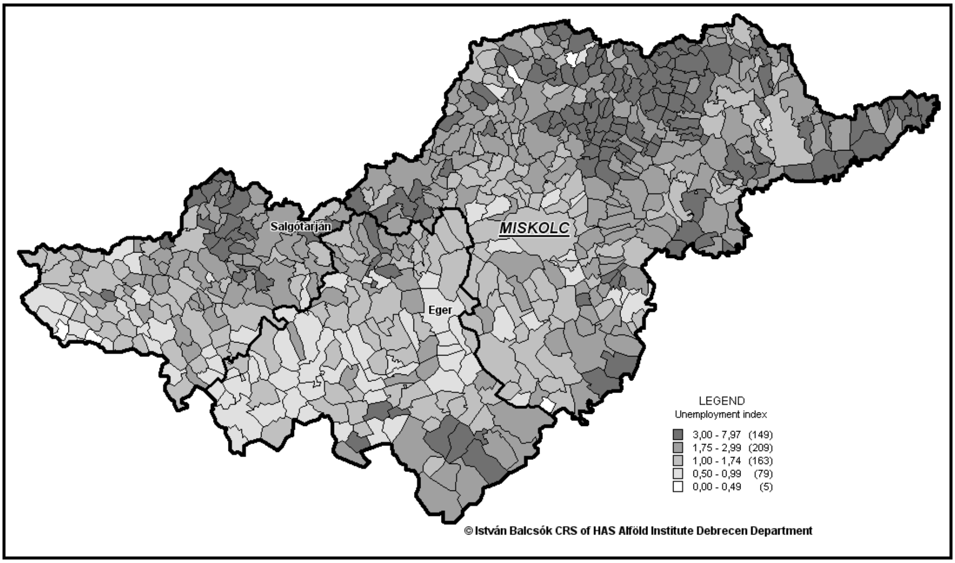
This deindustrialisation, although at a slower pace, continued after the turn of the millennium, which is indicated by the decrease of the number of workforce employed in industry. The number of employment in industry in the region of North Hungary fell from 99,409 in 2001 to 87,671 by 2007, which is an 11.8% decline. This rate is more than four times the decrease at national level, which is 2.7%. The industry of Nógrád county suffered an especially great loss, where the total number of employment dropped by more than a third. In Borsod-Abaúj-Zemplén county, concentrating more than half of all industrial employees of the region, the decline was 10.6%, while Heves showed some increase (of 1.3%) in the same period.

The crisis of the raw material and energetics sector resulted in the decline of processing industry as well, and the result was the unemployment rate that has been the highest in Hungary for a long time. The general crisis of the industrial sectors in a basically industrial region also put service sectors into a difficult situation, due to the drastic decline of solvent demand. Perhaps the most serious "by-product" of the economic restructuring is the appearance of mass unemployment, which became critical in the early 1990s especially in those areas that struggled with a number of other socio-economic problems anyway. The still palpable detrimental effects of this process are well demonstrated by the fact that in nine micro-regions of Borsod-Abaúj-Zemplén there are more than three non-working persons for each employee.

The level of unemployment in the region is still far above the national average, and the formerly existing spatial disparities have not decreased substantially, either. On the basis of data from December 2008, there were only 84 municipalities from all settlements of the region where unemployment rate remained below the national average, while in about a hundred and fifty settlements the rates are at least three times higher than that. The present spatial structure of unemployment reflects the previously described transformation of the economy and employment, i.e. the most favourable situation can be observed in the more urbanised areas of Heves county, south of the M3 Motorway. As regards the relative index of unemployment (unemployment rate compared to the national average), the other extreme is the Borsod Industrial District and its catchment area and the industrialised areas of Nógrád, indicating the survival of acute employment problems (*Figure 1*).

Figure 1.

Unemployment rates in the settlements of North Hungary, in December 2008 (national average = 1)



Source: Edited by the authors on the basis of data from the Public Employment Service.

The lack of employment opportunities is indicated by the high number of the long-term unemployed. It is also a negative fact that the composition of the unemployed by schooling is worse than the national average; the proportion of those with only eight classes of primary school education, or even less, exceeds the national average, while in the circle of those with higher qualifications the proportions are always lower. Another factor which is a disadvantage from the aspect of economic modernisation is that, in connection with the more limited performance of the 'competitive sector' (private sector), the proportion of those employed by the budgetary organisations (e.g. by education or health care) exceeds the national average.

Partly because of the unfavourable structure of the human resources and even more so due to the lack of developed infrastructure, investments avoided the region for a long time, even if they showed up, they were only interested in privatisation. The real breakthrough was brought by the construction of the section of the M3 Motorway in the region, creating the basic conditions for the attraction of investment capital. By this time, however, the motivations of the investors had changed; cheap labour, the comparative advantage of the region, was no longer attractive enough for direct investment. In the now EU member Hungary it is innovativeness, and the presence of well trained experts that create good conditions. On the whole we can say that the substitution of the lost jobs in industry is a slow and problematic process, investors mostly targeted the less depressed areas in good transport geographical positions and less typically the depressed areas.

Compared to other sectors, energetic industry has become the main target area of foreign direct investment, although it usually was restricted to the buy-out of existing capacities. From the region’s own sources of raw materials suitable for energy production, the deep mines of brown coal have been closed down by now, but the strategic importance of opencast lignite mines has increased, and brown coal has partly been substituted by biomass.

Among the dominant energy production companies of the region, the AES Borsod Energetics Ltd. and the AES Tisza Power Plant Ltd. are practically 100% properties of foreign investors, while foreign capital has a 72.63% share in the Mátra Power Plant Co. The inclusion of foreign direct investment saved the main centres of electrical energy production in the region, and the modernisation of the establishments often resulted in the expansion of the capacities, in addition to the improved efficiency. Brand new capacities, however, were only created by the Hungarian Power Companies Ltd. in Lőrinci and Sajószöged, by the construction of reserve gas-turbine power plants, in order to secure the long-term provision of Hungary with electricity.

The relationship of environmental industry and energy production

The socio-economic processes taking place after the systemic change and briefly introduced above have impacts still palpable today. Taking these into consideration we can say with certainty that the environmental industry is a real opportunity for the region of North Hungary. Coming from its infrastructure and servicing character, environmental industry plays an important role among the dominant factors of economic development. Energy as a cost factor is a factor that basically determines the competitiveness of several economic activities. In the private consumption the increase of the process of energy influences in the long run the living standards, the general wellbeing.

An industry that has a dynamically growing worldwide market and requires primarily knowledge and creativity as investments can be the engine of innovation and a pull sector of the economy, similarly to informatics and biotechnology. The usability of the theoretical possibilities, however, is significantly influenced by the social and political reactions: the environmental industry in Hungary – similarly to other countries – depends in very many respects on then environmental policy decisions. Compared to other sectors, environmental industry – coming from its knowledge-intensive character, among other things – is an especially regulation-oriented sector. Similarly to energy production, much depends on what quotas the authorities define, what products and services they consider environment friendly and wish to support (*Kollányi–Liska,* 2009).

Together with the formation a joint energy strategy for the decrease of the oil dependency of Europe, the European Commission sees global climate change as one of the most serious challenges. It is not surprising that in addition to the increase of energy efficiency, the innovation of technologies related to environmental industry enjoy a special support. The EU sees the probably several decades of the transformation of the energetics sector and the penetration of climate friendly technologies as a strategic possibility that will create millions of jobs and will be one of the engines of the economic revival of the Community.

In harmony with the objectives of the EU, the number one complex development programme in the development strategy of the North Hungary region aims at the creation of a competitive economy, within which the third sub-programme also serves the improvement of the quality of the environment. This programme involves the introduction of environmental industry and the promotion of the penetration of an energy sector built on renewable sources of energy. Among the areas of intervention in environmental industry, the already operating energy production centres are of selected importance. Among the sources of renewable energy, the most important are those that rely on agriculture, i.e. those methods of the production of biomass for energy that also induce major rural development impacts by the creation of new jobs. In addition to biomass it is potential geothermal energy sources that are given a selected emphasis at regional scale.

The use of biomass for energy production in electric power plants

Under the heading ‘electric power producers’ we mean power plants which can be base load power plants, regulated power plants and peak power plants. Electric energy is a special “product” that cannot be stored economically as yet, so each moment so much energy should be produced that the consumers demand. At any moment of time, the constantly changing demand of the customers should be satisfied jointly by the Hungarian power plants and the imported energy. Base load power plants are those units that should be constantly operated, for economic considerations. Regulated power plants follow the changes in the demand of the customers, while peak power plants are needed so that the short daily demand peaks can be managed.

In Hungary the majority of the power plants companies are privatised, the ownership pattern of the smaller scale (industrial, renewable energy etc.) power plants is quite varied. Looking at the age structure of the power plants we can see that there are many old energy production units operating with a lower efficiency. Taking the present situation into consideration it is not too promising for the future that the after elimination of the purchase obligation laid down in long-term contracts, the construction of a power plant is now the own risk of the investor, which is not favourable for the construction of new power plants.

It is important to remark about the safety of the energy supply of the region of North Hungary that several base load power plants and regulated power plants can be found in the region, supplemented by small nominal capacity hydroelectric plants; also, wind power plants have appeared in the recent years, although in a limited number so far. As an effect of the new market and environmental conditions, the Borsod Power Plant formerly using brown coal is now a wood-fired plant, while the Tisza I. plant uses partly black coal and partly biomass now, instead of brown coal. In the power plant of Lőrinci (170 MW) and Sajószöged (120 MW), two gas turbines were installed, which are now reserves, two rapidly usable peak power plants. The total electricity output of the major power plants of the Hungarian electricity production system is 8,041.6 MW, of which 2,550.7 MW (31.7%) is produced in the region of North Hungary.

In the European Union, like in Hungary, a surplus is produced year after year in some areas of food-oriented agricultural activities. Partly due to the shrinking of the market possibilities and partly because of the increased international competition, the goods produced can often hardly be sold. Holding back production could improve the marketing possibilities, but this solution would evidently worsen the living of the producers.

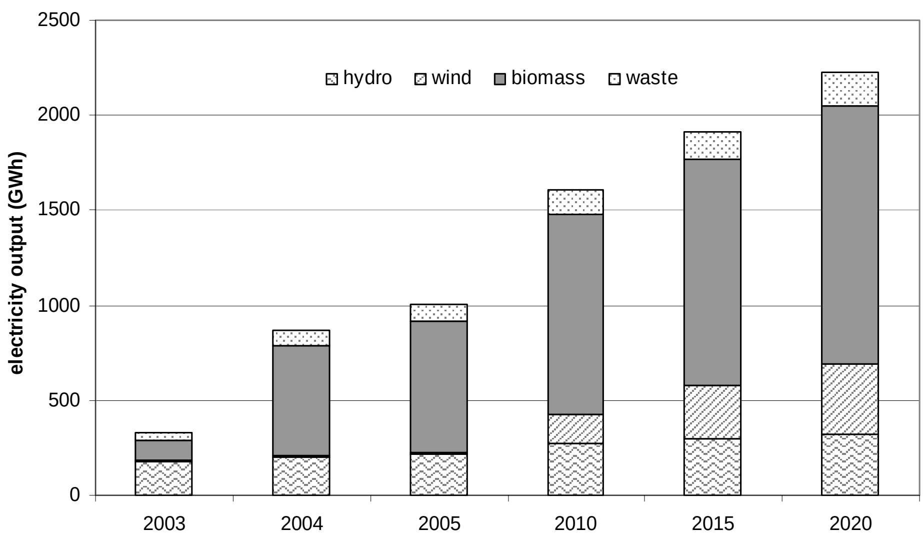
One possible solution for this contradictory situation, an alternative securing the maintenance of the present production level and the profit of the producers is to feed the surplus into the energy supply system. The technologies available are suitable for this purpose, despite some existing problems. Another advantage of this solution is that it allows the EU to meet its obligations accepted in Kyoto, because the use of biomass is neutral for the carbon-dioxide balance: it emits as much carbon-dioxide as much was absorbed by the plants during their life cycles (*Gyulai,* 2006).

The use of biomass for energy production in Hungary is basically determined by the directives of the European Union. The main objective of these directives now is encouragement, because it is unlikely to have sharp competition in this sector until 2010 due to the excessive use of the resources (*Baranyi,* 2007). The present Hungarian legal frameworks too aim at increasing the volume of production, as the utilisation of the resources available is at a low level, and similarly to most of the European countries, the expansion is rather slow compared to the objectives set.

From the total energy consumption of Hungary, the proportion of renewable energy is not more than 3.2–3.6% presently, of which just 2.8% is plant biomass, while in Europe it is the fifth most important source of energy within the group of renewable energies. In electric energy production, on the other hand, its share is outstandingly high within the renewable energies, it reached 71.8% in Hungary in 2004, being the highest figure among all the member states of the European Union. This favourable situation, however, is due to a very new process, which started in 2002 by the use of a significant amount of solid biomass in the coal-fired power plants, and the reconstruction of the powers stations. The share of the formerly dominant hydroelectric energy decreased to 22.2%, while the biggest development opportunities can be seen in the use of wind energy in the coming decade (*Figure 2*).

Figure 2.

The share of renewable energies from electricity production, 2003–2020



Source: Tombor, 2005.

As in the majority of the European countries, also in Hungary it is solid biomass that has the primary role among the renewable energies used for heating.

In the recent years its volume even increased, by 7% annually in the average of the years from 1997 to 2004. The production of 265 ktoe energy production by the end of this period is a considerable achievement, reflecting how much the volume of wood used for electrical energy production increased. Geothermal energy can also play an important role in heating in the future, its relative growth rate is double of the increase of biomass use, and its sources have more reserves, as opposed to the use of solid biomass whose more extended use for energy production is not allowed by the environmental regulations.

The total biomass stock of Hungary is estimated to be around 350 to 360 million tons, from which 105–110 tons of primary biomass is reproduced every year, and most of it is already used. The basis characteristics of land use in Hungary are well indicated by the fact that the annual primary production of cereals exceeds that of the forests. Every year some 4.0–4.5 tons of cereal straws is produced in Hungary, approximately 45% of which is consumed by animal husbandry and industry, while the rest would be suitable for the production of 28-34 PJ energy. The amount of non-used maize stems is even higher, but its higher humidity content does not allow an adequate efficiency with the present incineration techniques used in Hungary.

The presently most widespread method for the use of biomass for energetics purposes is incineration. Solid biomass can be burnt in small or large furnaces. Smaller devices (below 40 kW) can directly provide households with energy for heating, hot water and cooking. Wood-fired equipments (firesides and cookers) are traditional, the necessary modernisation and automation can improve their efficiency, and also serve comfort and environmental protection. They produce approximately 18–19 PJ/annum, which could be increased to some 22 PJ/year.

Medium-sized units (40 kW–1.5 MW) usually serve the heating, hot water production and technology heat supply of municipalities and their public institutions, semi-detached houses or businesses. Connected electrical energy production is not typical even in this output category. The most important developments of the last years have been implemented in Hungary in the field of electrical energy production: large capacity power plant shifted partly or totally from coal firing to the use of biomass; three of these can be found in the territory of North Hungary.

The total amount of biomass burnt in the power plants of Visonta, Berente and Tiszapalkonya exceeded 40% of the national consumption in all five years. In the amount of burnt biomass there was a very rapid growth from 2003 to 2005 by the gradual appearance of new actors, and then a slight decline occurred, followed by growth again in the last three years – although at a pace somewhat slower than formerly (*Table 1*).

Table 1.

The volume of biomass burnt in the power plants of Hungary (TJ/a)

Power plants	2003	2004	2005	2006	2007	2008	Total amount of biomass burnt in 2008 (%)
Mátra – Visonta	0	0	5,102	2,177	4,034	6,826	28.5
AES – Berente	1,084	2,825	3,824	2,432	3,767	3,746	15.6
AES – Tiszapalkonya	0	1,088	2,856	2,103	94	0	0.0
Region of North Hungary	1,084	3,913	11,782	6,712	7,895	10,590	44.2
Bakony – Ajka	0	2,627	3,481	3,329	3,992	5,319	22.2
Vértes – Oroszlány	0	0	0	732	1,796	3,430	14.3
Pannongreen – Pécs	0	1,501	4,269	4,550	4,665	4,614	19.2
Total	1,084	8,041	19,532	15,323	18,348	23,953	100.0

Source: Stróbl, 2009.

Te demand for electrical energy produced from renewable sources is expected to further increase in the long run. This is especially important for North Hungary because the use of renewable energy, in addition to its growing use in power plants, also has a favourable impact on employment through forestry and the related businesses. The connection of the advantages for the environment and the society is served by the energy plantations induced by the power plants, as they increase at a growing pace the absorption of a greenhouse gas, carbon-dioxide, and are also a significant market for the labour supply of the region.

Looking at the power plants playing a dominant role in the energy production of the region we must mention the biggest coal-fired power plant of Hungary, the Mátra Power Plant in Visonta, with a 941 MW built-in capacity, which primarily uses Hungarian sources, the lignite mined in the open-cast mines of Bükkábrány and Visonta since 1969. The average availability of the power plant is over 70% and it provides 12–13% of the total energy demand of Hungary. The Mátra Power Plant Co., with its technology built on lignite firing, is able to utilise a considerable amount of biomass, and examinations have been carried out since 2000 for the use of the theoretical potential in practice.

In the recent years experiments have been made for the joint incineration of several materials considered as biomass (by-products and wastes of traditional agricultural products, wastes of forestry and wood processing, plants grown for energetics purposes, fodder plants, animal biomass and mud from sewage treatment), and joint incineration is still going on. As regards the amounts used, however, there have been significant changes in the recent years, which is due mainly to the changing legal and market environment.

In the Mátra Power Plant the main direction is still the utilisation of biomass in lignite-fired furnaces, and the energy produced can be transferred to the consumers through the existing systems. The multiple use of the capacity of the built-out systems significantly decreases the specific investment costs of the use of biomass. Due to the transport distance that plays a dominant role in the utilisation of green energy carriers, the Mátra Power Plant can economically use the biomass produced in Heves county in the first place.

The Borsod Power Plant was constructed between 1951 and 1957 for the utilisation of the Borsod brown coal and for the supply of the Borsod industrial region with energy. It produces condensation electricity power, in addition to the united national electricity system for the industrial plants, mines and settlements in the area, and it also produced industrial steam and hot water for the neighbouring industrial establishments and the town of Kazincbarcika for decades. During the privatisation of the Hungarian energy sector this power plant was bought by the America based AES Company in 1996.

However, serious environmental and economical concerns emerged in relation to the operation of the power plant. The available low quality brown coal, because of its high ash content and especially its high sulphur content, is not up to the environmental norms, and the high fuel costs and the low efficiency make the electrical energy produced unmarketable. On the other hand, the infrastructure of the plant is still available, or with a smaller scale and less expensive transformation it can be used for up-to-date energy production using wood as fuel.

The implementation of biomass incineration required substantial investments in the power plant, such as the reception of the wood by rail and road, the transport and storage of wood in the power plant, the instalment of a wood shredder and the loading of the wood chips into the furnace and its efficient incineration. In the Borsod Power Plant the production of renewable energy started in May 2002, by the use of sawdust mixed with the coal. By the transformation of two furnaces, after 2003 an approximately annual 30MW of electrical energy production capacity was built out on pure biomass basis (*Lukács Gergely,* 2008).

Presently the power plant mostly burns firewood, 250–300 thousand tons a year, which it procures from four state forestry companies and several private forests. The significance of agricultural wastes is much smaller. Biomass is burnt mixed with coal, but the transformations have allowed a pure biomass burning as well.

Given the operational experiences, because of the existing energetics background, the costs of investment were much lower than they would have been in the case of a greenfield biomass burning plant. The average efficiency of the furnaces was raised from 74% to 82–84%. The transformations resulted in a capacity to burn approximately 400 thousand tons of firewood a year and the production of 330 GWh of electrical energy on the basis of renewable energy. Further enlargement is limited by the continuous supply of fuel in adequate quantity. The examination of several possibilities or the extension of the sources of biomass has started (more effective collection of wastes, establishment of energy plantations, and use of straw and energy grass).

The Tiszapalkonya Power Plant can be found on the bank of Tisza River, five kilometres away from Tiszaújváros. As regards the structure of this plant built between 1953 and 1958, it is a classic coal-fired power plant, which was bought by the AES in 1996, together with the Borsod and the Tisza II. power plants. Originally it had a nominal capacity of 200 MW, but it has been technically updated and transformed several times during its operation. Of the eight steam furnaces installed originally, four are still operating. The high pressure coal dust fired furnaces have 125 t/h steam production capacity individually, condensation electrical energy production is done by three turbo engine groups of 55 MW capacity.

The changes of the efficiency and environmental protection expectations made it necessary to start a biomass project also in the Tiszapalkonya Power Plant in 2003, to substitute the Hungarian brown coal with high sulphur and ash content and low heating value. As a result of the technology change and the transformation of the furnaces, in furnaces 1 and 2 it is possible now to burn biomass in 100%, while furnaces 3 and 4 are now suitable for the incineration of very good quality imported black coal in 100%. Thank to the modernisation and the change of fuel, the emission of sulphur-dioxide and dust decreased by 90%, nitrogen-oxide by 60% and carbon-dioxide emission by 50% compared to the emissions of the previous years (*Drótos,* 2008).

Despite the altogether very favourable effects, however, the shrinking of the resources on the market of renewable fuels resulted in changes in 2007 that did not allow the Tiszapalkonya Power Plant to purchase an adequate quantity of fuel at a reasonable price. Consequently the AES-Borsod Energetics Ltd. wants to produce electrical energy in the power plant on coal basis, at a low cost and keeping the low emission threshold limits meeting the environmental regulations in effect. This way it is possible to save a large-scale industrial plant of Northeast Hungary which largely contributes to the easement of the economic difficulties of the region.

The use of biomass in power plants

From the three counties of the region it is only Nógrád that does not have major power plant capacities, so it had no possibility to use biomass, primarily wood and wood chips, for the production of electrical energy. It is the most forested county of Hungary (38.7%), and new power plants have been built recently for the utilisation of the local resources (*Lukács Gergely,* 2007).

Balassagyarmat was the first settlement of the region where biomass was used for heat and electrical energy production, by the incineration of 12 thousand tons of wood chips annually in a furnace of 2 MW nominal capacity. On the basis of the favourable experiences, the hospital of the town also switched to biomass heating in January 2009, installing a 2,5 MW capacity power plant and furnace house, the fuel of which is provided by the mixed wood waste collected at Hungarian wood processing establishments. The next step is the construction of a 4 MW capacity power plant in 2009, supplying remote heating for the neighbouring institutions of the local government and the homes in one-third of the town.

Also in Nógrád county, in the micro-region of Balassagyarmat we find the village of Bercel with its 2,047 inhabitants, where the modernisation of the heating of eight public institutions was implemented by the shift to the use of biomass. In addition to the favourable environmental impacts, considerable economic advantages were achieved, as 80% of the former gas use could be substituted this way.

The Károly Róbert College of Gyöngyös, in the framework of the project called BIOENKRF supported by the National Office for Research and Technology, established a 0.6+0.4 MW capacity power plant in Tass-puszta, whose primary goal – in addition to economical operation – is to serve as the location of experiments promoting the more widespread use of biomass. Accordingly it can be operated also in summer, but its rural development effects cannot be measured yet because the use of the 0.3 hectare greenhouses connected to the establishment is not continuous. The experiences gathered so far make it clear that that in any given location the instalment of several small furnaces may be more rational than the use of one single large-capacity furnace. For the utilisation of the maximum capacity of both furnaces, in addition to the heating of the neighbouring buildings there are plans for the construction of a new, approximately 0.7 hectare plastic house in the near future.

Plans for the establishment of new biomass heated power plants in the region

As a result of the previously introduced, mostly successful projects, in several settlements of the region there are plans for the utilisation of the biomass potential, although the ideas are not always very popular with the local inhabitant ands especially the businesses. In Salgótarján there has been a plan since 2006 for the construction of a 20–25 MW nominal capacity co-generation power plant using biomass, and according to the original plans it should have been built already. In addition to the production of electrical energy, the remaining waste heat energy could be used for the heating of the public buildings and the homes of Salgótarján. The raw material would basically be produced in the energy plantations to be established in territory of the Salgótarján and three neighbouring micro-regions, in addition to the forests that cover 44% of the territory now.

Based on the natural endowments and information gathered from the farmers on the spot, in approximately 7.5% of the agricultural lands the plantation of energy forests would be economical, while the transport distance would not exceed 30 kilometres in most cases. Like in the whole of the region, also in the micro-regions concerned the creation of new jobs generated by the project and the keeping of the jobs in danger is of selected significance, the number of which is between 120 and 170, depending on what proportion of the demand for wood is satisfied by the local energy plantations (*Lukács Gergely, 2008*).

Development plans have also been made for the biomass fired power plant to be established by German investors in the industrial park of Bátonyterenye, just 20 kilometres off Salgótarján. According to plans, the 49.9 MW capacity power plant and several connected units should start their operation in the industrial park of the town in October 2010. The implementation of the planned investment can be jeopardised by the fact that fuel for the operation of the power plant would be purchased from a much larger average distance, within a 100 kilometre circle, which raises serious environmental concerns about the investment.

Even more problems emerged in connection with the most famous and most contradictory project of the renewable energy investment planned in Hungary, the Straw-fired Power Plant of Szerencs, where the continuous protest of the local wine producers was given a great attention in the national media as well. The nominal capacity of the power plant, to be established in the vicinity of the Tokaj-Hegyalja wine producing region – part of the world heritage – is also 49.9 MW, remaining just below the threshold value of large-scale power plants, 50 MW. In the planned establishment, 270–280 thousand tons of straw and energy grass would be incinerated annually for electrical energy production in the furnaces imported from Denmark.

Despite the arguments of those who protest against the project – because of the endangerment of the present state of the environment, the world heritage title or their own production conditions –, the competent environmental authorities say that neither the energy production of the power plant nor the emissions generated by the supply of raw material will exceed the permitted threshold limit values. Taking all this into consideration, if certain conditions are met (look of the power plant in harmony with the landscape, if straw production does not significantly change land use in the region and if straw is transported to the power plant in and environment friendly way), the construction of the power plant can go on, and it will start its operation in early 2010 according to the plans.

Despite the debates induced by the real environmental risks, the main argument for the realisation of the investment is that the closedown of the sugar factory eliminated 111 jobs directly, and indirectly hundreds of employees lost their source of living in the area. The new straw-fired power plant can employ 133 people, while another 150 jobs can be created in the related establishments (sweet sorghum plant, bio-ethanol plant, pellet production and biomass dryer, and eco-manure production plant). This means that the new power plant, in addition to giving work to the majority of the ex-sugar factory workers, will create a significant number of new jobs and offers for the agricultural producers of the region a long term annual surplus income worth three billion Forints (calculated with the mean exchange rates of the NBH in 2008, € 119 million); also, it secures a long-term income for the local entrepreneurs involved in the construction.

The integration of biomass in remote heating supply can be significant in the towns of the region with a larger number of inhabitants, where the number of homes connected to the remote heating network is high. It is not surprising then that plans have also been made in the regional centre for the shift of the heating of two housing estates from gas to biomass basis, but this will not cover more than 2.5–3% of the total remote heating demand of the city in the beginning.

Generation of rural development impacts

In the recent decade, the use of biomass for energetics purposes has increased year after year in most of the European states. A slight decline or stagnation could be observed just in those countries (e.g. Finland or France) that already kept their production at a high level, using their good endowments. The largest expansion was seen in those countries where the share of renewable energies is smaller and where there are limited possibilities for the expansion of production anyway. Hungary belongs to these countries; without the large capacity wood fired power plants the country could not be able to keep its obligations for the growth of the proportion of renewable energies in electrical energy production.

The development ideas and the changes in the market show that in the longer run the utilisation of biomass will be around the limits of sustainable development in each country. After the expansion of international trade, a decline is expected due to the more optimal use of local resources, because not one country will be able to produce more solid biomass than whose energy content it can utilise.

The production of bio-energy in larger volume in the eastern half of the European Union is not blocked by natural limits for the time being, much more by the lack of capital and the underdeveloped technology. For most countries, the example of Austria, Denmark of Finland can be followed, where, taking the natural endowments and the characteristics of the settlement network into consideration, biomass fired power plants – and recently the smaller scale electrical energy production capacities too – are located very densely and evenly. Their proportion will significantly increase in the future, while the share of consumption in individual households will decrease (*Koncz,* 2008).

The role of the energy sector in employment is considerably increased if the raw materials are also produced in the region; in North Hungary, in addition to lignite, this mostly relates to biomass. Biomass fired power plants and electricity generation plants create few jobs in themselves, because at a high level of automation it is possible through internet connection to control the mechanised work processes from another settlement, maybe with one part-time staff employed. Still, extra workforce must not be hired just to fight unemployment, in each case the investments can be really competitive is capacity utilisation and efficiency are maximised. However, if furnaces manufactured in Hungary are installed, that also generates new incomes in Hungary, just like the maintenance of the furnaces. This is supplemented by the production, extraction and transport of the raw materials to be burnt.

The amount of biomass, presently coming from areas used by sylviculture, could be expanded by the plantation of energy forests, and from time to time by the clearing of the derelict areas. The use of biomass produced in energy plantations for energetics purposes requires 15 work phases based on living labour, which can be a great help in improving employment in the backward micro-regions. It would be reasonable to establish mixed use small-scale power plants in all 28 micro-regions of the region (*Baranyi–Nagyné Demeter,* 2008; *Nagyné Demeter,* 2007).

In employment in the rural areas agriculture still has to play a significant role, as the significance of agriculture is still one of the dominant features of "ruralness". Greenhouses, by the planting of labour intensive cultures, offer a possibility for hiring a large number of labour force, up to 5 to 10 times the number of those employed in energy production, although most of these employees would be unskilled or less skilled, but this may be especially important in the expansion of the labour market of the most backward areas. Taking the present European market of early vegetables into consideration, the demand for the products to be grown is expected to remain at high level in the future too (*Baranyi et al.,* 2008).

In order to increase the sustainability of green energy projects, at micro-regional scale the most possible complex developments should be implemented, maximising the number of jobs created in connection with the investments and the level of the utilisation of own, local resources. The use of biomass for energetics purposes is the activity that may result in the creation of the largest specific number of jobs. This is the activity that can be located in the most decentralised way in Hungary – after the use of solar energy –, and it can partly solve the problems of the agricultural sector and also has the strongest rural development impacts. It much more contributes to the democratisation of the energy production by making the collaboration of the very small actors of the energy market necessary in the framework of clusters or production and sales cooperatives, which may improve efficiency by the joint actions.

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ASPECTS OF THE LOCATION OF BIOENERGETICS COMPLEXES IN POORLY INDUSTRIALISED AREAS*

Dóra Nagy–Demeter

Importance of investments in bioenergetics

The significance of environmental industry investments in the most disadvantaged areas, like the micro-region of Baktalórántháza – the sample area of our survey – is especially great. The implementation of the bioenergetics complex in the respective micro-regions would greatly promote the elimination of the "vacuum" created by the closedown of processing industry establishments. The planned investment considerably improves the infrastructure conditions and the economic performance of the given area, making the micro-region attractive for the investors.

The real significance of the planned investment, a *2,400 MW nominal capacity combined cycle power plant* is given by the fact that it can utilise several types of agricultural waste: sewage mud, animal manure, communal waste, animal and plant by-products and energy plants. The *use of the waste heat* produced in the power plant further strengthens the regional development impacts of the power plant and the environment friendly character of the investment. The goal of the essay is to collect and analyse those socio-economic impacts induced by the investment which may effectively promote development in the region, can generate rural and spatial development impacts. For lack of space, the essay only focuses on those factors that have the strongest influence on the economic activity and the development of the micro-regions.

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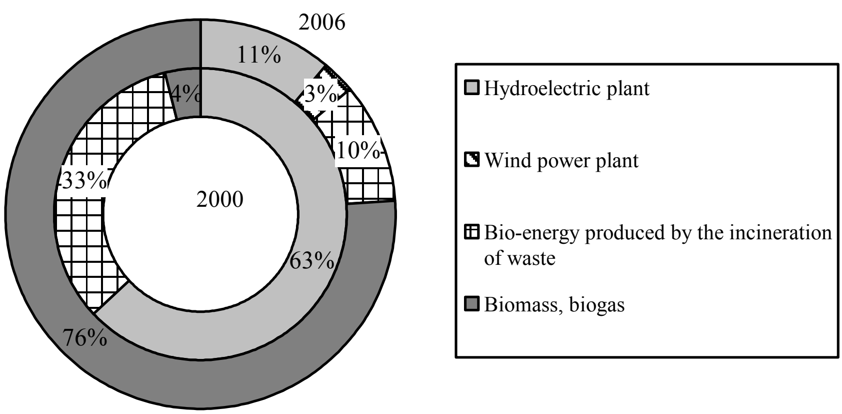
Renewable energies in Hungary

Since the turn of the millennium a considerable change has occurred in the use of the renewable energies (*Figure 1*). The amount of electrical energy produced from renewable sources of energy increased by 35% on the average (reaching 4.7% in total consumption by 2007). This way Hungary did not only meet but exceeded its obligation made to the EU, i.e. that the rate of renewable energy should reach 3.6% by 2010; still it is far from the 6% average in the European Union. In the period in question, the proportion of biomass and biogas within electrical energy production grew by leaps, which is primarily due to the mixed-fuel firing of the formerly coal-fired power plant blocks, the so-called "co-incineration". The spatial structural position of the Hungarian power plants thus could not change in the recent years, despite the more intensive utilisation of renewable energies.

Figure 1.

Amount of electrical energy produced from renewable energy sources, by types of renewable energy, 2000–2006

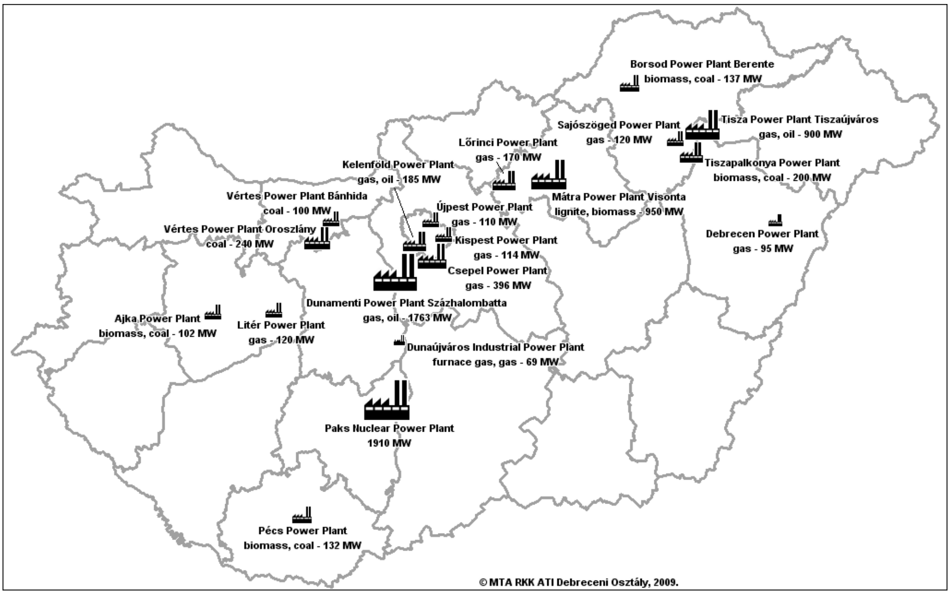


Source: by the author on the basis of 2006 data by the Hungarian Central Statistical Office.

Most power plants are located in the former heavy industry districts and Budapest, and the main location factors of the largest plants were the presence of cooling water, or the joint presence of cooling water and oil (*Figure 2*). It is visible in the map that neither of the two regions of the Great Hungarian Plain has considerable capacities, accordingly the proportion of energy demanding sectors is lower. The only power plant that should be mentioned in the North Great Plain region is the natural gas-fired plant operating in Debrecen, with a capacity of 95 MW.

Figure 2.

Built-in capacities of the large Hungarian power plants, 2003 (> 50 MW)



Source: Debrecen Department of the Great Plain Research Institute of the CRS of HAS, 2009.

During the expansion of the use of renewable energies, however, very strict regulations have to be met. On the basis of the endowments of Hungary, the use of biomass for energetics purposes can be a major possibility. The use of the energy sources of Hungary can only be comprehended as a kind of social-economic-ecological compromise and we cannot follow the attitude that we got used to when using fossil energies only (*Barótfi,* 2003).

The individual investments should be harmonised and the investments decentralised during the Hungarian energetics developments for the use of biomass. At the competitive investments, however, efficiency could be increased from both economic and environmental aspects, by the support of the smaller-scale developments built on the complex use of plant raw materials and the propagation of the biogas and biodiesel technologies suitable for producing the own demand of the agricultural businesses. (In the world there are approximately ten million biogas generators, the overwhelming majority of them in the poorest countries. In Hungary the main reason of their establishment was the decrease of the environment pollution of the large animal farms, and mainly power plants using western technologies are applied to weaken the dependency of Hungary on the energy import from Russia.)

Industry in the region of North Great Plain

The economy of the region was more deeply impacted by the social and economic transitions of the 1990s than other areas in Hungary, because coming from its geopolitical endowments its trade was much more eastward oriented – especially to the direction of the former Soviet Union – than the commercial activities of other Hungarian regions. Transition was successful especially in the large cities and the western parts of the region, and the multinational corporations locating in the region during the privatisation process implemented significant developments and investments. The *proportion of industrial employees* is lower than in the other – especially the Transdanubian – regions of Hungary, and it is manly certain branches of the processing industry (food industry, textile industry, chemical engineering) that have considerable traditions.

A special characteristics of the industrial structure of the North Great Plain region, coming from the natural endowments and the historical preliminaries is – in addition to the above-average share of *processing industry activities*, within them primarily the less up-to-date and competitive sectors – the much lower weight of mining and energetics than in other regions in Hungary. In addition to natural gas it is only raw materials of construction industry that are extracted, and only one of the large-capacity power plants (above 50 MW nominal capacity) of Hungary can be found in the region, in Debrecen. In the industrial structure of the North Great Plain region, within the circle of the dominant processing industry businesses it is the *food processing* establishments that still have a national significance.

More than 80% of the output of the *companies with more than 50 employees* is produced by processing industry in the region, followed by energetics sector (with its share of 17%) and only 1% is produced by mining. Statistical data show that *Szabolcs-Szatmár-Bereg county* has the most balanced industrial structure, as it has no such dominant sector as the other two counties have. Four activities produce 87% of the value of processing industry production (textile industry, food industry, chemical engineering and mechanical engineering), the first two has an almost 56% share (*Koncz*, 2008).

Characteristics of the energetics sector in the region

Szabolcs-Szatmár-Bereg county, as the northeast gateway of Hungary has an outstanding transit role, the *largest capacity pipelines and cables carrying energy run across the territory of the county*. The energetics concept of Szabolcs-Szatmár-Bereg county accordingly places special emphasis in energy production on the legal and financial support of the penetration of renewable energies which activate the inner resources of the region and take the aspects of the environment into consideration. The activity most important in this respect is the use of biomass for energetics purposes (*Baranyi et al.,* 2008*)*.

The *import route that used to be so important of the electrical energy supply of Hungary is out of order at the moment*, because of the lack of the connection of the UCTE and the IPS systems. According to the information received from the MAVIR (Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zártkörűen Működő Részvénytársaság, Hungarian Transmission System Operator Company Ltd.), in the Ukrainian–Hungarian and the Ukrainian–Slovak cross border areas the total capacity of cross-border electrical energy transmission is 455 MW presently. *According to the EU regulations, MAVIR does not have auctions in the Ukrainian–Hungarian cross-border area, so the transmission lines reaching the border are out of use at the moment*.

To the opposite, the utilisation level of the gas pipeline crossing the micro-region is very high. The pipeline carrying the natural gas imported from Russia crosses the Ukrainian–Hungarian border between Beregovo and Beregdaróc. Because along the gas pipeline, starting from the feed-in points the pressure of natural gas gradually decreases in the function of the streaming conditions, it was necessary to build a pressure booster compressor station, which operates in Beregdaróc. The natural gas pipelines of national importance, starting from the Ukrainian border and heading towards Tiszaújváros and Hajdúszoboszló run parallel to Vásárosnamény, and then they bifurcate in the Baktalórántháza micro-region.

The conditions for the construction of a new gas-fired power plant are absolutely excellent in the micro-region, because the *most important electric transmission lines and natural gas pipelines of Hungary run in the direct proximity of Baktalórántháza*. The construction of the power plant is more and more urgent because of the increased energy demand of Hungary and the termination of the lifespan of the existing power plant capacities, so a decision must be made on the location in the near future. Reasons for the location of the investment in the micro-region are the *relative backwardness of the* wider *region*, and the *presence of considerable and expandable industrial zones*. Not last, the location of the investment is close to the *Záhony Enterprise Zone*, which offers *favourable* *conditions for the newly implemented investments* and the *regional impacts of the re-loading zone can be expanded*. With a European Union investment worth almost 26.3 billion HUF (i.e. € 105 million, using the mean exchange rates of the NBH for 2008), a complex economic and infrastructure development programme will be implemented in Záhony until the end of 2011. The financial resources are used for raising the total turnover of goods from the present 5.3 million tons to 8.5 million tons, by the reconstruction of the railway infrastructure connected to the Ukrainian railway network, while the turnover of rail traffic may increase from the present 11 thousand wagon-loads to 215 thousand. The development will be completed until the end of 2010. In the region of the *North Great Plain*, in a shortage of energy production capacities, it is *absolutely necessary to construct a large-capacity power plant which would also create the basis of the European Union promoted regional energy supply systems in the region*.

In the territory of Szabolcs-Szatmár-Bereg county, bioenergetics investments of national importance have already been implemented. The energy demand of the remote heat production of Mátészalka is provided by the incineration of solid biomass, in a power plant whose gross capacity reaches 5 MW. Mátészalka also hosts one of the two operating *biodiesel plants* of Hungary, *suitable for the processing of 12 thousand tons of sunflower a year*. The *largest capacity biogas plant* of Hungary (with an electrical energy output of 2.5 MW) also operates in Szabolcs-Szatmár-Bereg county, in *Nyírbátor*. This is the biggest bioreactor now in Europe and also one of the largest in the world. This model and the reliable foreign technological experiences are a further guarantee for the construction of bioreactors in Hungary. A significant amount of experiences has been collected in the already operating units, which may contribute to the establishment of further production units in Szabolcs-Szatmár-Bereg county in the future, if conditions are given. The plans of the near future include several energetics investments in the territory of the county, the majority of which set as an objective the utilisation of biomass for energy production.

Location factors of the power plant complex and their impacts on the socio-economic conditions

The location factors of the planned investments that may influence the socio-economic development of the given region can be divided into six major groups. The basis of making these groups is the character and the direction of the possible future impacts. On this ground, in the micro-regions the following factors should be taken into consideration:

- development of the societal, economic and social welfare parameters, within this the improvement of employment indices and the expansion of vocational further trainings;

– connected logistics systems and the formation of a supplier system;
– infrastructure development;
– technological development.

Among these factors listed above, the essay only analyses here in details the *development of employment indices*, the *formation of connected logistics systems and a supplier system, infrastructure development* and the *direction and effect of technological developments*. For the analysis and introduction of the respective area, conclusions are mostly based, in addition to the available statistical data, on estimations induced from the possible future processes. If the investments are implemented in the two micro-regions, the description and analysis of the processes listed above should be done using primary data, as this could complete the research findings in the future.

Changes in the employment indices

The construction of the power plant has positive effects on employment in the region from several aspects, alleviating the problems of unemployment. The building out of the suppliers networks related to the power plant complex also has a huge significance in employment, especially in the sector of agriculture. Bioenergetics establishment are a sure purchase market for the supplying agricultural businesses, which contributes to their strengthening, the increase of their income generating capacities and which allows them to apply new production technologies and the modernisation of the technical background. As a result of all these, the significance of the agricultural enterprises and their role in employment increases, which has positive impacts on other sectors, strengthening thereby the economy and the competitiveness of the region.

The implementation of the planned investment will *modify the employment structure of the region*; energetics sector will appear as a new pull sector, having impacts on a number of other sectors, increasing e.g. the role of logistics and the profitability of agriculture. In fact, the development of the bioenergetics complex will probably also impact the R & D sector, among other things. The power plant will locate workplaces requiring special skills that have not had much tradition so far, and this will have impacts on training and education, i.e. the *skills level of the locally employed workforce will increase*. This is true not only for the energetics activities alone, because the businesses participating in the suppliers networks necessary for the servicing of the power plant complex will also have to meet certain quality requirements, which supposes the application of certain techniques for the acquisition of which trainings are also necessary.

It is important to remark, though, that the above-mentioned positive labour market processes can only take place with a significant support of the sectoral policy. The tender resources of the European Union and Hungary are of especially great importance. Such a programme is the presently running New Hungary Rural Development Programme (NHRDP) that provides grants for the use of renewable energies:

- for the procurement of tools necessary for the *competitive production of base materials* (in 2007 almost 43 billion HUF – i.e. € 171.1 million calculating with the annual mean exchange rate of the NBH – was awarded, and several of the tools purchased were used for the production of base materials for bioenergetics);
- in the field of *vocational training* and *skills transfer*, placing a special emphasis on the fields related to bioenergy;
- in the modernisation of animal farms, the *use of biogas* was given a special emphasis;
- *support for the procurement of biomass furnaces*;
- *plantation of* soft-stemmed and hard-stemmed *energy plants*.

Hungarian agriculture has great possibilities in the use of biomass for energetics purposes, this may considerably promote the *decrease of employment tensions* coming from the restructuring, the *preservation and expansion of job opportunities in the rural areas* and the preservation of the conditions of the rural habitats. In order to achieve this, a harmonised series of actions is needed, consisting partly of the provision of investment supports, of targeted research and development activities and of an integrated skills transfer and attitude shaping programme.

Building out of logistics systems and suppliers networks

The planned bioenergetics establishments using the waste heat of the gas-fired power plant will process a large amount of raw materials from agriculture. In order to achieve the continuous operation of the system and the best possible efficiency, large-scale *suppliers networks* must be built out. The gas-fired power plant requires a large amount of fuel itself, of course, but this comes from import and does not directly promote networking in the region.

The role of *suppliers networks* is especially important for the development of the micro-region and the region, because the large companies can have local and *spatial development impacts* through their suppliers networks, in addition to their significant employment effect. At the same time, the advanced suppliers relations also promote the acceptance of the respective company (in this case the power plant and the related bioenergetics establishments) and its embeddedness in the given region. The most important direct benefit for the economic development of the region is that the large companies provide a purchase market for the small and medium-sized enterprises of the area through the suppliers networks. In addition, the cooperations with the large companies allow the transfer of higher level management and organisational technology skills, and the requirement to constantly meet a higher quality level promotes the improvement of the competitiveness of the suppliers as well. In the present case the suppliers network will be of regional scale, in which the business to business relations will be the most important. At regional networks these business to business relations play the most important role, but both the inter-institutional cooperations and the collaborations of private persons are very important as well.

The creation of a *vertical type suppliers network* organised around a large company is expected, where the integrator is naturally the power plant complex and the SMEs (small and medium-sized enterprises) are organised around it. The power plant, more exactly the connected bioenergetics establishments primarily need base materials produced by agriculture (e.g. maize, sunflower, rape seed), so the *majority of the supplying SMEs will be agricultural businesses*.

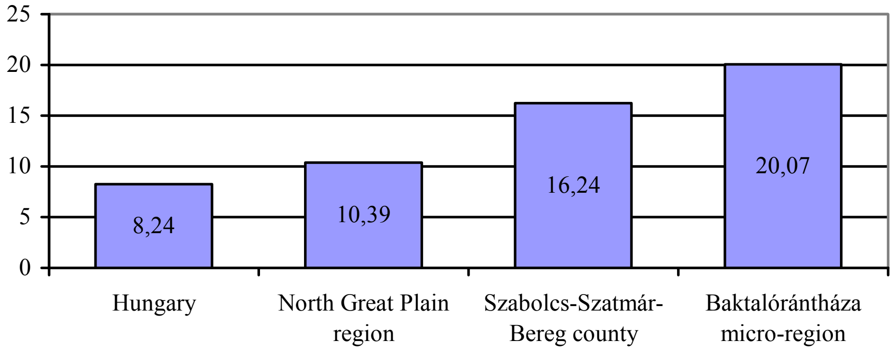
In 2007, the number of SMEs per one thousand inhabitants was less than ninety in the North Great Plain region (c.f. the national figure of 118). As regards their breakdown by legal form, private entrepreneurs made 65% and the rest were joint businesses, due to the strong regional dominance of agriculture. If the bioenergetics investments are realised, these proportions may improve, indicating the business development impact of the power plant complex. This impact will be palpable not only at micro-region but probably also at regional level. The number of agricultural businesses per one thousand inhabitants is almost 2.5 times the national average, and even in the North Great Plain region with a strong agricultural character this figure was only 10.39, just half of the figure of the micro-region (*Figure 3*). The majority of these enterprises, however, have marketing problems because of the lack of adequate markets.

The *building out of stable suppliers network has several advantages* for the SMEs. On the one hand, it gives a *security of sales*, and assists the *deposit of waste in accordance with the regulations*. In addition, in the favourable case the establishment of a *consultancy system* will also be necessary for the *production of quality goods* and the smooth servicing. A general phenomenon occurring at the organisation of such networks is that the integrator (the power plant in this case) organises trainings free of charge for their contracted partners, introducing the modern methods and procedures to them. In addition, it frequently happens that a large company provides the supplier with e.g. seeds in order to secure the adequate quality.

As a result of these processes, the *efficiency of production* increases and competitiveness of companies grows. In addition, being a member in a network has *financing advantages*, as the financial sector is keener on financing SMEs that have already become suppliers, because these companies have already achieved results, there is a constant demand for their products by the integrator – so the SME is less subject to market risks and the repayment of loans is more certain (*Baranyi et al.*, 2007a).

Figure 3.

Number of agricultural businesses per one thousand inhabitants, 2007



Source: by the author on the basis of the data from TEIR (Országos Területfejlesztési és Területrendezési Információs Rendszer, National Regional Development and Spatial Planning Information System).

Although in this case it is evidently agricultural businesses that play a dominant role in the building out of suppliers networks, other sector may play a role as well. The operation of the planned bioenergetics establishment will have a considerable impact on the transport sector. The transport of bio-fuels and the by-products produced in large quantity during biodiesel and bio-ethanol manufacturing and of the raw materials necessary for the production will boost local transport, on the one hand, and may result in the development of the agricultural services sector, on the other hand, which is evidently a favourable process.

Infrastructure development

In the catch-up and in speeding up of the economic growth of any region, the *development of infrastructure plays a selected role*. One of the most important and also the most striking impacts of the power plant complex will be seen in the development of infrastructure. Of course the infrastructure investments and developments necessary for the adequate operation of the energetics establishments will have to be implemented in a multi-actor cooperation in which, in addition to the power plant, the state, the municipalities and other companies will have to play an active role.

For the high level operation of the planned power plant complex, developments are necessary in practically all fields of infrastructure in the region. One of the most important is the developments connected to the energetics infrastructure, because after their completion the gas-fired power plant and the connected bioenergetics establishments will significantly alter the energetics map of Hungary, rearranging its former structure. If we consider that 4,000–4,500 MW of electric energy production capacity will have to be closed down in Hungary in the coming 15 years (mostly formerly built, obsolete fossil fuel fired large power plants), parallel to an ever increasing consumption, the power plant complex planned in the Baktalórántháza micro-region will change the spatial structure of the energy production of Hungary even more strikingly.

The power plant will use a large amount of natural gas for the production of electrical energy, gained from the nearby pipelines coming from Russia through the Ukraine, so it will not be necessary to construct a longer pipeline. However, for the provision of the predictable, safe and continuous operation of the power plant, the construction of a significant *natural gas storage capacity* will be necessary, so that the production level should not decrease in case of a temporary decrease in the amount of the supplied gas (like it already happened in the recent past, as an effect of the Russian-Ukrainian gas disputes). The *construction of* significant *storage capacities* is also required by the connected bioenergetics establishments, because these process a large amount of agricultural base materials that have to be stored and dried. In addition, the temporary storage of produced biodiesel and bio-ethanol will be necessary, while electrical energy, as it cannot be stored economically, will be forwarded directly to the national electricity transport network.

In the satisfaction of the demands of the power plant, transportation is of basic importance, consequently the plant requires a *large capacity transport infrastructure*. Expensive transport investments will be paid partly by the power plant (e.g. the construction of service roads, costs of the construction of industrial railway), but the traffic generated by the power plant will also burden roads the development of which is clearly the task of the state.

The gas-fired power plant itself will not use much the roads and railways of the area, but the transport demand of the connected bioenergetics establishments is much bigger. Oil plants necessary for the manufacturing of biodiesel and maize, the most important base material of bio-ethanol production will be transported by road or rail (the latter will be more economical in longer distances and for larger quantities, due to the costs of reloading). The operation of suppliers network will heavily burden the main transport routes of the region, so the enlargement of the capacity of the roads is justified.

A favourable circumstance is that the expansion of the speedway network of Hungary concerns the region by the construction of the M3 Motorway right to the Hungarian–Ukrainian border, connecting the micro-region to Nyíregyháza from one direction and also providing an access to the Ukrainian border at Záhony and Barabás. In the best case, however, the power plant complex may start its operation before the planned completion of the motorway section, and in this case the increased traffic will have to be managed by the public roads until the motorway is built. The most important public road providing an access to the micro-region is the road No. 41, which is already heavily used, and it would probably be unable to manage the growing traffic without development. Because of this it would be practical to speed up the construction of the M3 motorway section from Nyíregyháza to Vásárosnamény, as it would serve the interests of not only the power plant but of the whole area (*Baranyi et al.*, 2007b).

Besides the development of railway infrastructure it is indispensable to improve the conditions of road transport as well, so in the framework of the New Hungary Development Plan some 6.9 billion HUF (€ 27.5 million if we use the 2008 mean exchange rates of the NBH) is allocated for the construction of new roads in the area. By these developments the first phase of the construction of the road connecting Tiszabezdéd to Záhony will be completed, the bypass roads around Fényeslitke and Komoró will be built and the section between Tiszabezdéd and Komoró renewed. The investments are expected to be completed by late 2011.

Technological development

The businesses and their products supplied, participating in the suppliers network of the power plant using sate-of-the-art technologies will have to meet certain fixed quality criteria. This is not always an easy task, as the production of the agricultural base materials used by the bioenergetics establishments may considerably be influenced by weather conditions.

The objectives of the power plant and the suppliers are the same in matters of quality: it is the *smooth provision of raw material supply, i.e. stabilisation of the supply of base materials*. Electrical energy production operates with practically zero tolerance, so the deviations from the amounts and quality fixed in the contract cannot be accepted or only very limited changes are approved. For example, in the case of oil plants necessary for biodiesel production, a maximum of 10% change in the oil content is allowed, if the change exceeds this threshold, the buyer may not be willing to purchase the base material from the supplier. These strict quality criteria can only be met by increasing the technological safety.

During the technology developments, several methods can be applied at the same time. In this process *research and development has an important role to play*, because this sector can produce innovations necessary for the technological developments from plant improvement to the production of new pesticides to inventing up-to-date production methods. Agricultural researches have traditions in the region of the North Great Plain, as has agricultural higher education. The Centre of Agricultural Sciences of the University of Debrecen is a training and research institution acknowledged throughout Hungary, where there are several researches in progress at the moment, including the area of bioenergetics.

The requirements of the power plant complex against the technology developments implemented by the producers of base materials result in the improvement of the equipment of the participants in the suppliers network, their professional skills and experiences will expand, and they will be able to work in a system operating on the basis of quality criteria. As a result of all these, the viability of the agricultural enterprises will strengthen, allowing them to integrate into other suppliers networks in the future or survive on the market on their own.

Expected spatial development impacts of the environmental industry investment

The findings of the evaluation of the current situation and the conclusions drawn from that suggest that the *2,400 MW nominal capacity combined cycle power plant planned in the vicinity of Nyírtass* will have the following impacts:

- In addition to the creation of new jobs directly required by its operation on its location, the power plant complex will generate *positive external effects in the field of employment that are very important for the development of this high unemployment-stricken area, and not last decrease the expenses of the state on active employment policy tools*. As a result of this probably the spatial disparities which have greatly contributed to the evolution of the present socio-economic situation will also decrease.
- The *building out of the suppliers network* connected to the power plant *will have a very positive impact on the economy of the area*, which will be palpable not only in agriculture but also in other sectors, the *multiplier effects will increase the competitiveness of the region and decrease the amounts to be spent on catch-up by the state*.
- The power plant complex itself and the directly or indirectly connected *infrastructure investments and developments will all influence positively the development of the region, and basically also the interest of the external investors in the area*.

– *Technological progress* generated by the bioenergetics complex *may be huge*, taking the present situation of the region into consideration. As opposed to the few investments that have located in this region since the systemic change, the *power plant is a real R & D investment*. It will be an investment that is not built on unskilled and cheap labour, maintaining this way the possibility of moving on (mainly eastwards). Also, it will guarantee continuous technological renewal and developments.

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