Environmental Engineering and Management Journal

February 2013, Vol.12, No. 2, 237-244
http://omicron.ch.tuiasi.ro/EEMJ/

"Gheorghe Asachi" Technical University of Iasi, Romania

REGIONAL DEVELOPMENT AND ESTABLISHMENT OF RENEWABLE ENERGY CLUSTERS IN NORTH-WEST REGION OF ROMANIA

József Benedek[1, 2*], Marius Cristea[1], Blanka Bartók[1]

[1]*Babeş-Bolyai University, Faculty of Geography, 5-7 Clinicilor Street, 40006 Cluj-Napoca, Romania*
[2]*Miskolc University, Faculty of Economics, 3515 Miskolc-Egyetemvaros, Hungary*

Abstract

In order to link the question of renewable energy to regional development and territorial cohesion, the article aims to present and evaluate recent initiatives taking place in the North-West Development Region of Romania, with emphasis on emerging renewable energy clusters. Moreover, we will present a case-study on geothermal energy cluster in Northern Transylvania. The state-of-art analysis is a result of a previous FP7 project, while the action plan has been derived from its results in a participative way, through organizing a focus-group session with all relevant stakeholders. Such initiatives come to support the idea that decentralized energy production may successfully contribute to regional development and cohesion by providing income sources and creating employment opportunities.

Key words: action plan, geothermal energy cluster, regional development, renewable energy

Received: October 2012; Revised final: February, 2013; Accepted: February, 2013

1. Introduction

The Lisbon Treaty added two new priorities to the EU policy, namely energy and territorial cohesion, completing the economic and social cohesion pillars of the previous Treaty. Although the linkages between territorial cohesion and sustainable energy are further underlined by the new document "Towards a new energy strategy for Europe 2011-2020" (EP, 2010), the scientific work in this field is still poor. According to the Directive 2009/28/EC of the European Parliament and of the European Council on the promotion of the use of sources from renewable energy (EP and EC, 2009), the Commission and the Member States should support national and regional development measures in this area, encourage the academic research and technology transfer of scientific research towards enterprises but also promote the use of structural funding in this area.

In order to link the question of sustainable energy to that of territorial cohesion, the article aims to present and evaluate recent initiatives taking place in the North-West Development Region, with an emphasis on emerging renewable energy clusters. Such initiatives come to support the idea that decentralized energy production may contribute successfully to territorial cohesion by reducing intraregional disparities (Hanley and Nevin, 1999).

2. Material and methods. Theoretical background

There is an abundant literature dealing with the issues of regional development, all focusing on the idea of networking, of agglomeration or clustering but also on their potential to contribute towards reducing the regional disparities. Moreover, these disparities are continuously increasing on sub-national level, as policies targeting territorial cohesion have failed to address them properly.

* Author to whom all correspondence should be addressed: E-mail: jozsef@geografie.ubbcluj.ro; Phone: 0040/264-596116/218; Fax: 0040/264-597988

Most scientific contribution on clustering are related with Michael Porter`s work on clusters (Porter 1990, 1998), which has exercised a huge influence on the regional development policy literature and praxis. He advances the idea that competitive advantages are generated at national and regional level by the spatial agglomeration of industry in the form of industrial clusters. Moreover, these clusters are able to ensure territorial cohesion by transferring positive externalities to lagging regions. In this first research period the literature has focused on two major issues: how to copy the most successful cluster, Silicon Valley in California, and how to apply or criticize Michael Porter's concept of clusters (Teräs, 2011). Even though Porter`s theory is generally accepted, there are still controversies on the scale of analysis (Benneworth et al., 2003; Benneworth and Henry, 2004; Lovering, 1999; Raco, 1999). The current term of cluster is similar to the one given by Porter, namely, the cluster is a geographical agglomeration of interconnected companies and associated institutions in a particular economic sector. Based on this definition, Hendry and Brown defined industrial clusters as 'loose networks of independent economic agents in the same or related market segment and restrictive geographic locality' (Hendry and Brown, 2006).

Ron Martin and Peter Sunley have developed an evolutionary perspective, considering clusters as products of path-dependent process (Martin and Sunley, 2006). Menzel and Fornahl (2010) are going a step forwards in creating a new evolutionary model of clusters based on the life cycle model. This model is highly valuing the case study research of context-specific cluster dynamics, a standpoint which we consider and adopted for our research.

One of the latest theoretical evolutions is related to Giuliani (2007) who developed an actor based knowledge network approach, stressing out the membership in one cluster does not lead automatically to benefits. Cumbers and Mackinnon (2004), Bathelt and Dewald (2008) introduced or developed the cluster-based regional development policies. They consider that clustering confers an economic advantage on participants over non-participants, creating spillover effects on the host community. Cluster based policies remain the core approach in most national and regional economic development strategies (Cumbers and Mackinnon, 2004).

The last decade brought a new approach in regional development, respectively the need to incorporate environmental issues (Gibbs, 2006). New concepts, such as the New Regionalism and Smart Growth state the necessity of considering sustainable regional and urban development (Scott, 2007). Moreover, industrial ecologists (Baas and Boons, 2004, Deutz and Gibbs, 2008; Gertler, 1995) argue that 'industrial ecosystems', similar to the natural ones, consisting of networks of interchanges between proximate firms, eco-clusters, are special cases of the cluster concept which are introducing the environmental dimension in the cluster policy and regional development.

The originality of our paper is twofold. Firstly, we present the formation of an emerging cluster in a transition economy. The cluster literature, although abundant, does not include many in-depth analyses of cluster emergence (Teräs, 2011). The definition of cluster is problematic from the viewpoint of emerging clusters. Emerging clusters are neither large concentration of firms and related institutions nor agglomeration providing benefits for every member of the cluster. Therefore, we have to consider the analyzed renewable cluster in Romania as an emerging cluster, which has a certain, yet unrealized potential to form into a functioning cluster. We will focus on the factors which contributed to the establishment of an emerging cluster. On this way, we try to bring new evidence towards developing a theory of emerging clusters. Second, we address in our paper a sensitive environmental issue (renewable energy) in the framework of regional development. In this line, we adopt the ideas from industrial ecology (Deutz and Gibbs, 2011), considering renewable energy clusters as a special form of clusters, which links the question of development and sustainability. As a consequence, we interpret the implementation of renewable energy clusters as a policy initiative and also as an environmentally based variant of cluster policy.

3. Results and discussion

3.1. Energy policy in Romania

The energy sector in Romania is overregulated (11 legal regulations) with no guidelines accordingly to the results of the FP7 project "Clustherm" (NWRDA, 2010). The general direction of the new directive of the European Union on the use of energy from renewable sources is that each member state has to improve the energy utilization from renewable sources till 2020. This regulation foresees for Romania an increase of the utilization of renewable sources from 17.8% to 24% (EP and EC, 2009). In this context, important stakeholders have an increasing interest in projects dealing with renewable energy.

In the last five years, Romania has developed important strategic planning documents relevant for the renewable energy sector:

A) The National Strategy for Sustainable Development, which promotes the production of electricity from renewable energy sources, indicating a requirement that the share of electricity produced from renewable energy sources in the gross electricity consumption nationwide is expected to reach 33% in 2020;

B) The National Strategy for Energy Efficiency, with the main aim to reduce primary energy intensity by 40% until 2015 by reducing energy consumption, especially in the residential and industrial sector.

The document concludes that the implementation of energy efficiency measures will increase the economic competitiveness of Romania;

C) The National Development Plan for 2007-2013 in which the first priority line of action refers to stimulate a more competitive and knowledge-based economy and also to improve energy efficiency and using renewable energy to reduce climate change.

The cluster policy builds in this general framework, a new tool of regional development, which has created between 2010 and 2012 the first renewable energy clusters in Romania: Romanian Water (including geothermal) Cluster (North-West and Center Development Regions), Romanian Cluster Towards Green Energy (South-Muntenia Development Region), ROSENC Romania (West Development Region), Green Energy – Innovative Biomass Cluster (Center Development Region), and TREC – Transnational Renewable Energy Cluster in Cluj County (North-West Development Region). In order to better coordinate and promote the new cluster policy, the Romanian Cluster Association was established in 2011. Currently, clusters can obtain EU funding through the 2007-2013 Sectoral Operational Programme for Economic Competitiveness, creating competitiveness poles, national and transnational cooperation.

3.2. Energy industry and renewable energy in North-West Romania

In the North-West development region there were 167 companies active in the field of energy in 2010 (NIS, 2011), representing 17.7% of the Romanian energy companies. Only 7 companies have over 250 employees, 95.8% being SMEs (out of which 82% have less than 10 employees). Most of these companies are located in Cluj County (63), the county with the highest development level in the North-West region, followed by Bistrita-Nasaud (39) and Satu Mare (22). Very relevant is the fact that the number of active companies registered at regional level in this field has doubled in only two years, from 72 in 2008 to 167 in 2010, while the total number of business active in other sectors saw a decline of 13.5% in the same period.

The total turnover of these 167 companies reached 2265 mil. lei in 2010, 0.3% down against 2008 representing around 2.6% of the regional GDP. The total contribution of the region to the Romanian energy sector in terms of turnover was 4.5% in 2010. The sub-sector of electricity trading made up for 61.7% of the total turnover, followed by the sub-sector of electricity distribution which represented 14.7% of the total businesses.

As Table 1 shows, the sub-sector of electricity generation makes up for less than 1% of the regional energy industry. Anyway, we have to keep in mind that most of the big companies active in this sub-sector are officially registered in Bucharest but they have secondary branches in each region (e.g. Electrica, Electrocentrale, Hidroelectrica, etc.). Therefore, the real share of the North-West region in this sector is surely bigger.

The companies with Romanian capital generate 95% of the turnover in the energy sector, mostly through state-owned companies active in distribution and trading. Although there are 58 companies with foreign capital registered in the North-West Region, they generate only 5% of total turnover of the energy sector, as most of these companies have no activity at the moment. This slight share of foreign capital can be explained by the fact that the North-West Region is among the last two regions in Romania with public companies dealing with the distribution and sale of electricity. On the other hand, due to the global crisis most of the start-ups with foreign capital have encountered problems in carrying out their power plant projects.

The most important actors of the regional energy market are the power plants (heating companies) from Oradea, Zalău and Cluj-Napoca, all using fossil fuels, while the most important company using renewable energy is „Hidroelectrica", that operates hydropower plants in two counties (two branches) in the North-West Development Region – in Cluj and Bihor. The subsidiary from Cluj operates 23 hydropower plants with a total production of 750 GWh in 2010, the most significant being the ones in Tarniţa and Mărişel. The Bihor (Oradea) branch operates 16 hydropower plants, producing almost 600 GWh of electricity in 2010.

Regarding the power plants for renewable energy, there are 34 projects in the North-West Region that have received the agreement of the national authorities to connect to the Romanian National Energetic System, with a total installed capacity of 151.5 MW (1.7% of total installed capacity of all renewable energy projects in Romania).

Table 2 shows that the North-West Region tends to specialize in the production of energy from biomass and water, as the project under development here cover 58.8%, respectively 29,2% of the total installed capacity that will be developed in the following years in Romania. Most projects are located in Bistrita-Nasaud (11), Maramures (8) and Satu Mare (6).

Table 3 indicates that counties are also oriented towards a certain specialization: Maramures in hydroenergy, Bistrita-Nasaud in solar and hydroenergy, Cluj in solar energy, Satu-Mare in solar and biomass energy, etc., influenced by the different availability of renewable resources.

We have to note here that this list of projects does not include less mature initiatives that have not yet requested the permission to connect to the national energy system (for example the Tarnita-Lapustesti Hydroelectric Power Station).

Table 1. Companies activating in the energy sector in the North-West Region, 2012 (according to National Trade Register Office, http://www.onrc.ro/)

Sub-sector	*Activity Classification (NACE 2 rev. 2009)*	*Total turnover (Mil. Lei – 31.12.2010)*	*% of Sector`s total turnover*	*Number of employees (31.12.2010)*	*% of Sector`s total employment*
Distribution of energy	3513	511.758	22.6	2020	50.9
Energy trade	3514	1400.785	61.8	417	10.5
Electricity generation	3511	17.082	0.8	255	0.6
Steam (Heating power) production	3530	335.375	14.8	1278	38.0
TOTAL		**2265.000**	**100.0**	**3970**	**100.0**

Table 2. Renewable energy projects under development in North-West Region, 2012 (according to Romanian Wind Energy Association, http://rwea.ro/)

Source of renewable energy	*Romania*		*North-West Region*	
	Number of projects	*Installed capacity (MW)*	*Number of projects*	*Installed capacity (MW)*
Wind	234	8824.46	1	70.2
Water	67	104.98	17	30.68
Solar	52	218.96	10	38.14
Biomass	8	21.19	4	12.47
Biogas	2	3.64	0	0
Cogeneration	9	841.23	0	0
TOTAL	372	10014.46	32	151.49

Table 3. Renewable energy projects under development in North-West Region, by county and resources, 2012 (according to Romanian Wind Energy Association, http://rwea.ro/)

County	*Solar*	*Wind*	*Water*	*Biomass*
Bihor	1	1	3	0
Bistrita-Nasaud	5	0	5	1
Cluj	2	0	0	0
Maramures	0	0	8	0
Satu Mare	2	0	1	3
Salaj	0	0	0	0
TOTAL	**10**	**1**	**17**	**4**

3.3. The Romanian Geothermal Energy Cluster – North West Region

The North-West region has the natural potential to effectively harness geothermal sources. It concentrates an important energy potential: almoust half of the Romanian thermal water resources are located in the North-West Region, more exactlt in two counties of the region, Bihor and Satu-Mare. The aquifers in the North-West region of Romania have triassic, pannonian and lower pannonian origin. However, as the drillings in the different kind of formations also occur at different depths, we can assume that there are more separate layers of thermal aquifers in one lithological unit. The temperature is generally very high, even in the case of lower depth drillings (ICEMENERG, 2010).

In Romania the exploration and research for geothermal resources began in 1962 and over 200 wells have been drilled proving the existence of low enthalpy geothermal resources with temperature of 40-120 °C. At present about 137 MWt are used from about 61 active wells producing hot water in the temperature range of 55-115 °C (NWRDA, 2010). The geothermal resources of the region are very good exploited since the number of used wells compared to the existing ones is very high. On the other hand, there are also some destroyed wells especially in rural areas where no destination was found. Concerning the use of thermal water in the North-West Region we can see that almost half of the wells are closed and only one is linked to industrial activities. One third of the wells are however used in tourism, sector which develops very fast in Oradea, Tăşnad, and in a relative important number of rural settlements.

Within the region there are 3 companies dealing with thermal water, out of which two are also involved in research activities in this field. The reason is, that in the North-West region there are some companies which have a wide range of activities including also research. So they are using the resource of geothermal water and to improve their own performance they are also active in research. Another advantage is that a new project

involves companies with various profiles, fact which leads to a more successful project management.

Only two actors are involved in R&D activities in the field of geothermal energy: the state University of Oradea and one private company (TRANSGEX S.A.), which have developed projects for geothermal water utilization and resource assessment. For this point the biggest advantage would be to collaborate in terms of thermal water research, as the utilization methods and applications are still in development. Only a small amount (2.68%) of the geothermal energy produced in the North-West Region is used for tourism activities.

In 2009, a number of 10 relevant organizations (universities, SMEs, research institutes, public bodies and NGOs) with activities in the field of geothermal resources from four Central European countries with significant such resources (Hungary, Austria, Romania and Croatia) gathered their efforts to create an international geothermal cluster in the FP7 project – Clustherm. The partners have decided to estalish 4 working groups: Energy; Geology, Hydro-Geology and Reservoir Management; Environmental Protection and Chemistry; Health and Balneology (Tourism).

Each partner had to prepare a State of Art study analyzing the natural resources, the good practices in the management of geothermal potential and the current national legislation dealing with this topic. In order to validate the result of these regional analysis, workshops with all relevant actors (SMEs, public authorities, NGOs, universities, researchers, etc.) were organized in each partner region (North-West Romania was one of them). The one for the North-West region was organized in Oradea, in October 2009.

On the basis of the State of the Art Analysis for the North-West region, the following problems (weaknesses) have been identified:

1. low research potential and the low mobility of researchers in the field of geothermal research;
2. the poor state of research capacity;
3.low impact of awareness raising and dissemination activities amongst decision makers;
4. poor risk and geothermal water management;
5. low utilization rate of thermal resources in some areas for health tourism.

In order to achieve the main objective of establishing a Geothermal Cluster, to make it functional and to overcome the problems identified above, the following actions have been proposed which will form the five objectives of the Joint Action Plan:

1. To increase research potential and researcher mobility;
2. To develop the research capacity of local actors;
3. To increase the impact of dissemination activities and improve awareness raising;
4. To improve the risk management and sustainable geothermal water management;
5. To improve health tourism in the benefit of local economies.

The Action Plan has been set up in a participative approach, during a focus-group session that took place in 2010 in Oradea, gathering all the relevant stakeholders at regional level (public authorities, universities, research institutes, companies, NGOs of public interest, researchers, consultancy companies, etc.). In the following we present the above mentioned objectives and the corresponding measures of the action plan.

Objective 1 – To increase research potential and researcher mobility

Measure 1.1. Stimulating the international mobility of young researchers – by attracting young researchers with attractive scholarships and professional stimuli and linking young researchers eager to obtain work experience abroad via the Euraxess website

This measure comes to respond to the main challenge identified by the partners in the Clustherm project namely, the low research potential and the almost inexistent mobility of researchers between different universities and research centres from countries in Central Europe, where geothermal resources are concentrated.

Measure 1.2. Supporting the inter-sectoral mobility of researchers – by activities such as offering the possibility for post-doctoral researchers to work for a limited amount of time at different companies getting acquainted with the technical aspect of the subject they are studying, while giving valuable scientific input to the host organization

By implementing these activities we expect to see an increase in the mobility of researchers between the business environment and the academic one with long-term benefits for technology transfer activities.

Objective 2 – To develop the research capacity of local actors

Measure 2.1. Improve and share the research infrastructure in the field of thermal water utilization – aims to analyze and categorize the infrastructural background in the research and expert organization and to create harmonious relationships between partners and universities/research institutes located in the region but also from abroad, regarding the use of infrastructure. Pilot actions would be initiated for the development and common use of the research infrastructure. This measure comes to support the research resources of local actors, which are currently characterized by poor infrastructure.

Measure 2.2. Improve, develop and harmonize databases – creating a Common Knowledge Base – by establishing a common database for sharing information on thermal wells, aquifers, experts and events.

The lack of knowledge and information exchanges between different kind of actors and different countries is one conclusion of the Clustherm

project. By creating a common database it is expected that the exploitation of geothermal resources will become more efficient and beneficial for the regional and local economies.

Measure 2.3. Support research and commercial projects (personal consultancy for cluster members, training, events) – through organizing thematic Workshops for research institutions, SMEs and public authorities and supporting the participation of SMEs in R&D projects through consultancy and the elaboration of applications. The small number of partnerships registered in the geothermal sector, especially of those between academia and business is one the weaknesses indicated by all stakeholders in this industry.

Objective 3 – To increase the impact of dissemination activities and improve awareness raising

Clustherm analysis concludes that the most important weakness of the geothermal industry is the low impact of awareness raising and dissemination activities amongst decision makers, making these resources peripheral in the current debate on renewable energy. We propose a set of measures that target a more efficient dissemination strategy and improved awareness on the sector`s specifics:

Measure 3.1. Developing tools for continuous awareness raising and networking among local actors (both public and private) in the field of thermal water utilization /web page – aims at developing a common cluster webpage, a common image and corporate design including online communication tools in order to strengthen the influencing power of researchers/decision makers working in the field of geothermal water utilization. This measure should also sustain the common attendance to national and international events.

Measure 3.2. Annual Meetings of the Members of the Cluster – consists of organizing the Cluster`s Annual Conferences, emphasizing on the power of the common communication and preparing the agenda of activities for the following year.

Measure 3.3. Elaborating a common set of marketing tools to promote the Geothermal Cluster – by elaborating a visual identity manual, elaborate brochures and promotion materials respectively, including a section on the portal with promotional instruments.

Measure 3.4. Facilitating the exchange of experiences through study visits and transnational workshops – through organizing study visits, staff exchange programs, good practice transfers, local dissemination seminars and ensuring the involvement of local actors in the exchange of experience.

Measure 3.5. Strengthening the cooperation with other organizations at EU and national level – by elaborating a database with all relevant organizations that we have access to and those which we would like to have connections with but also by elaborating a calendar of relevant events.

Measure 3.6. Improve the knowledge and technology transfer between research institutions, public authorities and SMEs – by creating a Knowledge and Technology Transfer Office with the purpose of exploiting intellectual property rights, by marketing activities, licensing, patents and valuation.

Measure 3.7. Initiating pilot projects - through brainstorming sessions, exchange of ideas and contests for innovative project ideas for the utilization of thermal water in Universities.

Objective 4 – To improve the risk management and sustainable geothermal water management

The poor risk and geothermal water management have also been identified as very significant weaknesses of the geothermal sector mostly because of the fuzzy legislation and regulating bodies, but also of the lack of a sustainable exploitation culture among companies and even citizens.

We have shaped for the upcoming geothermal cluster some measures that target the improvement of risk and water management, based on the best practices from E.U.:

Measure 4.1. Establishing a National GEOFUND – to promote the use of geothermal energy by establishing National GeoFund in order to overcome financial barriers regarding the lack of funding and taking up part of the risk.

Measure 4.2. Providing the necessary financial resources for the cluster - through Pilot Action in each working group.

Measure 4.3. Lobbying for the interests of cluster`s members at regional, country and European level – by creating a lobby network and close cooperation (networking); preparing a lobbying action plan.

Measure 4.5. Implementing the sustainable use of thermal water with regard to the European Water Framework Directives – by elaborating a study with an emphasis on sustainability of thermal water utilization, a strategy for the sustainable use of geothermal resources and policy recommendations on sustainability.

Objective 5 – To improve health tourism in the benefit of local economies

Although tourism is the main sector that benefits from the exploitation of geothermal resources, the potential is still not fully utilized especially, in remote rural areas where there are no other economic activities and the rate of unemployment is very high.

Further steps to improve health tourism in the benefit of local communities are to be done by the future Geothermal Cluster. We purpose some measures in this direction:

Measure 5.1. Developing health tourism based on thermal water – through establishing of strategic partnerships (public-private), finding financing sources for start-up phase and developing quality services.

Measure 5.2. Developing balneotherapy as a means of supporting local economies – by elaborating need-assessment analysis of the population frequently using balneotherapy, analyzing local resources and the diseases they might cure and elaborating a regional specific Action Plan for developing balneotherapy.

4. Conclusions

Some of the renewable energy cluster initiatives are being led by regional development agencies (the Central and the North-West Regional Development Agencies). This is a positive example for other initiatives which have the aim of introducing the principles of sustainable growth into regional development documents. However, the failure in setting up these networks or in reaching their high expectations sends a clear signal that attempting to implement the principles of green growth will not provide a simple, economically advantageous means to addressing environmental issues through a regional development strategy.

Renewable energy clusters share the common difficulties and uncertainties of other approaches in terms of transferring the successful features from one location to another. The Clustherm cluster was not created de novo, it is based on existing local and regional potentials.

Although failing to establish a geothermal functioning cluster, Clustherm can be seen as an emerging, potential 'green' cluster, resulted from the combination of knowledge, high-technology activities and traditional industries. Therefore, our policy recommendations are given in accordance to this early stage of evolution in which the analyzed cluster is found. Successful clusters are difficult to generate without favourable preconditions such as common interests and a culture of cooperation. The latest proves to be a difficult task in Romania, because of the lasting communist past when cooperation was forced in a top-down level and the private ownership was almost totally eliminated.

Acknowledgements

This work was possible with the financial support of the Sectoral Operational Programme for Human Resources Development 2007-2013, co-financed by the European Social Fund, under the project number POSDRU/107/1.5/S/76841 with the title „Modern Doctoral Studies: Internationalization and Interdisciplinarity".

References

Baas F.A., Boons L.W., (2004), An industrial ecology project in practice: exploring the boundaries of decision-making levels in regional industrial systems, *Journal of Cleaner Production,* **12**, 1073-1085.

Bathelt H., Dewald U., (2008), Ideas for a relational regional policy und cluster support (in german), *Zeitschrift für Wirtschaftsgeographie,* **52**, 163-179.

Benedek J., Kurkó I., (2011), Evolution and Characteristics of Territorial Economic Disparities in Romania, *Club of Economics in Miskolc: Theory Methodology Practice*, **7**, 5-15.

Benneworth P., Danson M., Raines P., Whittam G., (2003), Confusing clusters? Making sense of the cluster approach in theory and practice, *European Planning Studies,* **11**, 511-520.

Benneworth P.S., Henry N., (2004), "Where is the value added in the cluster approach? Hermeneutic theorizing, economic geography and clusters as a multi-perspectival approach", *Urban Studies,* **41**, 1011-1023.

Cumbers A., Mackinnon D., (2004), Introduction: Clusters in urban and regional development, *Urban Studies,* **41**, 959-969.

Deutz P., Gibbs D., (2008), Industrial Ecology and Regional Development: Eco-Industrial Development as Cluster Policy, *Regional Studies,* **42**, 1313-1328.

EC, (2009), Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, *Official Journal of the European Union,* **140**, 16-62.

EP, (2010), Resolution of 25 November 2010 on Towards a new Energy Strategy for Europe 2011-2020, European Parliament,(2010/2108(INI)).

Gertler N., (1995), Industrial Ecosystems: Developing sustainable industrial structures, MSc thesis, MIT. http://www.smartcommunities.ncat.org/business/gertler2.shtml, accessed 16.11.2011.

Gibbs D., (2006), Prospects for an environmental economic geography: linking ecological modernization and regulationist approaches, *Economic Geography*, **82**, 193-215

Giuliani E., (2007), The selective nature of knowledge networks in clusters: evidence from the wine industry, *Journal of Economic Geography,* **7**, 139-168.

Hanley N., Nevin C., (1999), Appraising renewable energy developments in remote communities: the case of the North Assynt Estate, Scotland, *Energy Policy,* **27**, 527-47.

Hendry C., Brown J., (2006), Dynamics of clustering and performance in the UK opto-electronics industry. *Regional Studies*, **40**, 707-725.

ICEMENERG, (2010), Study on the evaluation of the actual Romanian renewable source`s energetic potential, identifying the best location for investing in non-conventional electricity facilities.

Lovering J., (1999), Theory led by policy: The inadequacies of the 'New Regionalism' (Illustrated from the case of Wales), *International Journal of Urban and Regional Research,* **23**, 379-395.

Martin R.L., Sunley P.J., (2006), Path dependence and regional economic evolution, *Journal of Economic Geography*, **6**, 395-437.

Menzel M.-P., Fornahl D., (2010), Cluster lyfe cycles – dimensions and rationales of cluster evolution, *Industrial and corporate change*, **19**, 205-238.

National Trade Register Office, (2012), Financial Standing Publicity, On line at: http://www.onrc.ro/english/publicity.php

NIS, (2011), Tempo Online Database, National Institute of Statistics, On line at: https://statistici.insse.ro/shop/.

NWRDA, (2006), The Regional Development Plan 2007-2013, North-West Regional Development Agency, On line at: http://www.north-west.ro/en/SERVICESFor-Regional-Development/REGIONALPLANNING/Regional-Development-Plan-20072013.html.

NWRDA, (2010), Clustherm Project: Benchmarking Study, North-West Regional Development Agency, 12-34.

Porter M.E., (1990), *The Competitive Advantage of Regions*. Macmillan, London.

Porter M.E., (1998), *On Competition*, Harvard Business School Press, Boston, MA.

Raco M., (1999), Competition, collaboration and the new industrial districts: Examining the institutional turn in local economic development, *Urban Studies*, **36**, 951-968.

Romanian Wind Energy Association (RWEA), (2012), Connection permits status at 27 Jan 2012, On line at: http://rwea.ro/statistici

Scott J.W., (2007), Smart Growth as urban reform: A pragmatic 'recoding' of the new regionalism, *Urban Studies*, **44,** 15-35.

Teräs J., (2011), Emerging clusters. Theoretical, empirical and Political Perspectives on the Initial Stage of Cluster Evolution, *Regional Studies*, **45**, 1290-1292.