

BIOMASS CLUSTERS INFLUENCE ON BUSINESS COMPETITIVENESS

Navickas V., Vojtovic S., Svazas M.*

Abstract: The main problem of the paper is that in today's world there is a necessity to provide alternative energy, which would not undermine environment and conserve finite world resources. Clusters of biomass can help make it reality, herewith promoting business competitiveness and growth. The aim of the paper – create a biomass cluster model that can be competitive in energy market. In scientific literature workings of biomass clusters and their influence to business competitiveness is comparatively little researched. In energy sector clusterization processes operate through usable fuel type, applying technologies for it, and later seeking energy users. Paper authors develop clusterization influence to competitiveness methodology suggest clusterization influence analyse separate case. In analysis pending regions, invoke Lithuanian case. Calculations show that cluster activity is oriented to wood wastes usage, and this lets achieve economic, social and environmental benefits. Following growth not only clusters members, but also country competitiveness, because strong local business provides a positive influence on country economy.

Keywords: competitiveness, biomass cluster, clusterization

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Introduction

Due to the changing environmental situation in the world, there is need for alternative energy resources that would produce energy while keeping balance with environment. Today it is visible, that for energy production there are most used coal, natural gas, and nuclear fuel. In order to essentially change the energy production manner, it is not enough to just divert resources for this purpose, because that requires a lot of financial and human resources. Transformation process can relieve companies wish concentrated resources for general purpose. This can help achieve not only environmental benefit, but also give clearly economic effect.

Turning to cooperation philosophy, the cluster concept is remembered, when companies operating in the sector, focus their resources towards a common economic objective. One of the most important ways to keep competitiveness nowadays is clusterization. With its assistance companies, which operate in the

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same sector, can concentrate their resources and create new benefits, penetrate markets, which theretofore weren't achievable. Clusters, working in the renewable energy sector, today are fairly rare. Some scientists performed consideration on how general green energy clusters will affect regional and economic development (McCauley and Stephens, 2013). There were considerations about computer-assisted green energy cluster creation opportunities (Krioukov et al., 2012). Recently, expressing sustainable development and renewable energy ideas, biomass usage is gaining major momentum. Researches indicate, that more active biomass usage can warrant then, when companies, which have different resources, crowd to cluster, which can provide energy producers with required raw material. Clusters enhance business competitiveness, because rationally used resources, let to suggest lower energy prices in comparison with fossil fuel usage. Biomass clusters are wide structure, which involves raw produce supply, preparation and its usage ranges. Clusters strength is characterized by that it can use municipal or public infrastructure, and then this doesn't require additional expense. Cluster competitiveness grows mostly when where exists favourable geographical position for cluster members and raw produce can be easily contributed, then remade and later used to produce electricity and heat energy. Authors accomplished researches show that active biomass usage arouse synergy effects, which assert new workplaces creation, energetic independence, taxes to country budget increase. There are few researches about economic benefit created by biomass clusters, so theme is fairly new. This situation is relate to this, that most developed countries yet invoke fossil fuel maintaining energy. By itself cluster structure is much more progressed forward – in the world exists various types of clusters, which are orient either to aim benefit for business, or to value added to creation in scientific research basis. In the cluster definition creation process distinguish oneself Porter (1998, 2000), Bernat (1999). Later, cluster theory is further developed by Delgado et al. (2010, 2014). Most of clusters definitions and structures are maintained by these scientist's works.

Novelty of the research. Authors' research indicates that clusters can grow business competitiveness through unused resources usable and available financial benefit from these resources. In order to achieve it, there is necessary flexible activity environment, where concentrate recourses are quickly directed to benefit source. This is achieved surplus value effect and solve not only financial, but also social and environmental issues, such as low-skilled people work places and waste management aspects.

Theoretical Background

Biomass cluster concept and components

In order to propose biomass cluster influence on business competitiveness, it is necessary to indicate basic cluster components and subjects, which is significant to participate in cluster activity. Main cluster uniqueness is this, that all subjects of the cluster must be site within 100 km range; in other case emerges likelihood of

reduced operational efficiency indexes. In addition, cluster activity is oriented to region energy demand gratification, with especially rare exception for export. The European Union's energy policy aims to decrease dependence on fossil fuels and to reduce greenhouse gas emissions. To that end, the EU promotes biomass-based energy production, in which biomass includes, for example, wood, wastes and energy crops (Hämäläinen et al., 2011). The traditional use of biomass that includes firewood, charcoal, forest residues etc., is generally confined to small-scale household uses. Modern biomass relates to large-scale uses of commercial biomass and usually substitutes conventional fossil fuel energy sources where it is a cheaper option (Anbumozhi et al., 2010). In various countries, biomass cluster structure significantly differs. For example, in Italy biomass cluster is wide spectre – operates in biomass preparation and use sectors (Francescato and Negrin, 2013). In Germany where is an extensive bioeconomic cluster, whose purpose is most effective use of wood and other biodegradable wastes, so they could create much more added value. Cluster has 50 subjects – companies, institutes, other scientific institutions. In France operates 71 with biomass usage and innovation related clusters. These structures makes scientific researches, engage in biomass production and usage, export of knowledge and equipment for foreign countries. For ordinarily function of biomass cluster there are needed these elements: biomass source (straw, wood waste place); biomass producers; biomass use equipment producers; market, which uses biomass and have the necessary network connections; also essential is that all cluster elements geographically must be stated near each other.

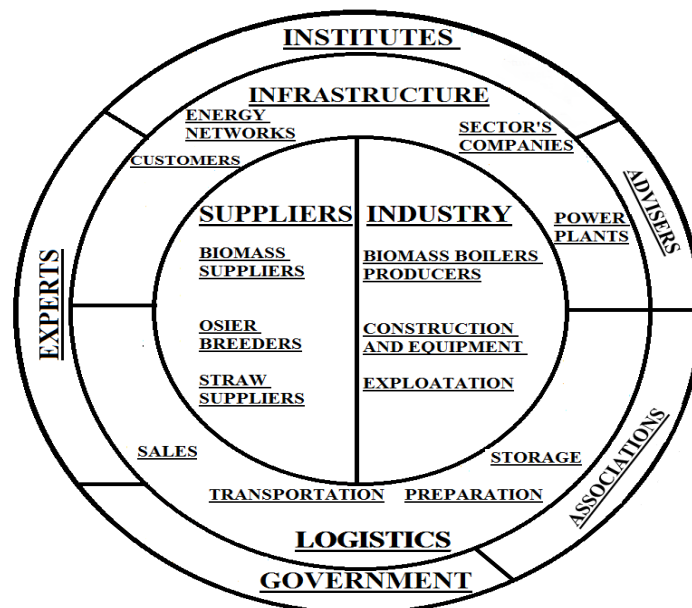


Figure 1. Biomass cluster model

Beside these elements attributable other institutions, which significantly contribute to effectivity of cluster functional support. Near industrial and usage potential of biomass cluster it is necessary to have experts and creative structures, who assist to increase cluster effectiveness.

Cluster can compile of three stages – main, supportive and advisory. On the main stage exist two sectors – biomass suppliers and biomass industry. Suppliers list include all biomass types – wood wastes, biological wastes, straw, osiers, etc. On purpose to warrant fixed this fuel expenditure, required biomass demand, which must secure industry, who provide powerhouse systems. Second cluster stage constitutes necessary infrastructure for cluster, which is in private, public and municipal format. For biomass cluster activity there can be found new infrastructure units, however the main parts are formed for a long time. An important role falls on logistic companies – they provide not only biomass preparation and supply infrastructure units, but also can distribute industry unit solutions for foreign countries, enhance cluster competitiveness and importance not only in activity country, but also over the country borders. In the advisory stage an important role performs scientific institutes, which suggest innovations for clusters, which can improve effectivity in cluster work and assist with creation of added value. Government regulates cluster action legitimation and form opportunities or establish handicap to separate cluster activities. In this model exists economic and energy experts, advisers, associations. These elements assists fluent work of cluster, coordinate and adjust to possible situation changes. Clusters activity are additionally developed by establishment research and development centres, which lets companies from different sectors together with academic institutions and other organizations to create new added value (Farinha et al., 2014).

Creativity and productivity aspiration encourages to join clusters and in turn encourage enterprise to raise business structures effectiveness and productiveness, and it is a key to sustainable development, which is emphasized in the world today (Vaz and Nijkamp, 2008). Regional industrial clusters can enlist and connect huge companies, thus forming agglomerate compounds. The main condition – specific geographical zone, where all business subjects can unify their strength and resources for teamwork (Lechner and Leyronas, 2012).

Flexible biomass cluster structure lets to fully provide regions with heat energy, and sustainably using available organic wastes it can also produce bulk of electricity. At the same time continuous improvement is in this structure, while scientific institution's search for decisions for effective growth in natural wastes burning or other treatment.

Research Methodology

Biomass cluster influence on business competitiveness investigation is based on indexes analysis of activity region. This is a basic factor on purpose to investigate cluster opportunities in the market. In this case Variation coefficient is used. This

meaning is established by real gross domestic product (RGDP), fall per capita, deviation from country average.

$$CV^w = \frac{\sqrt{\sum_{i=1}^n (y_{it} - y_t)^2 * p_{it}}}{y_t} \quad (1)$$

y_t – GDP per capita in analysis region group;

p_{it} – i-region meaning, considering regions population t years, that $\sum_{i=1}^n p_{it} = 1$

y_{it} – RGDP per capita in i-region t years.

This index normally conveys in percent, and is compared with other regions information.

Next index is to find out opportunities to pursue biomass business in several country regions. Regional coefficient (RQ) calculates by formula:

$$RQ = \frac{\frac{E_{ij}}{E_j}}{\frac{E_{in}}{E_n}} \quad RQ = \frac{\frac{E_{ij}}{E_{in}}}{\frac{E_j}{E_n}} \quad (2)$$

here: E_{ij} – employment i industry j region; E_j – general employment j region; E_{in} – national employment i industry; E_n – general national employment.

If regional coefficient exceeds 1, it means, that comparative employment in particular region and in particular industry is higher than average country employment. Accordingly, RQ below 1 demonstrate below average comparative employment in the particular region industry sector. If RQ higher than 1,25 it shows regional specialization in concrete industry sector.

In order to figure out how biomass usage would influent country economy, it is necessary to determine available raw produce and production potential. The potential evaluation is importantly in order to precise influence for country in economic point of view. For potential use negative influence can be constant changes in market situation. Therefore, both strategic resources, and strategic potential wise we can talk about the potential use degree. It will be shown by made production amount and implemented products amount and strategic potential relation:

$$MP = \frac{SP}{SPUG} \quad (3)$$

MP – Made production; SP – Strategic potential; SPRG – Strategic potential use degree

Under methodology, we can objectively investigate cluster opportunities in the market and its activity influence for the market. Herewith, there are distinguished regions, which show positive biomass circulation characteristics, thus let planned investment in them.

Research and Discussion

Clear biomass cluster structure shows cluster influence both on business competitiveness and activity region. Movement in particular region for companies in this sector generally brings active competitive battle between many business subjects, which are small. Cluster assists in simplifying activity in the market, because there emerges opportunity to share recourses, infrastructure, to form general customer basis, and available unemployed resources can divert for parallel benefit creation. In this case there are distinguished obvious directions which show how biomass cluster determines several subject changes and convey their benefit.

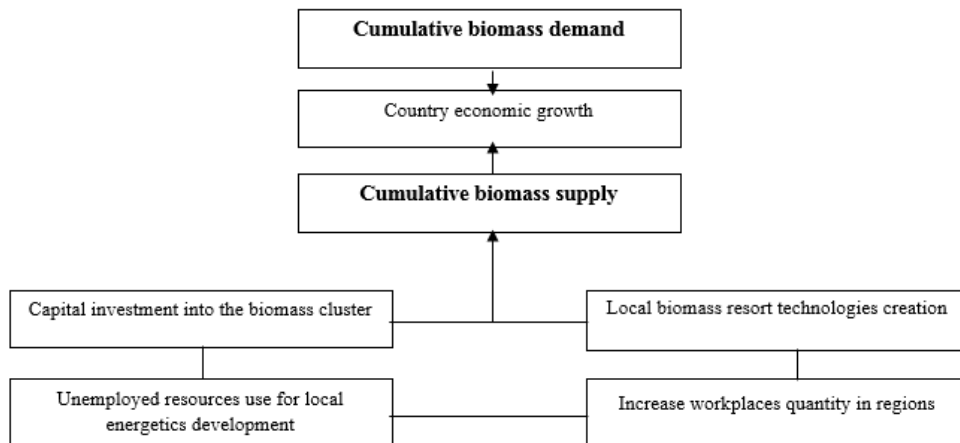


Figure 2. Biomass cluster influence for economic growth

There are distinguished these biomass cluster influence directions for competitiveness:

1. GDP increase. Biomass cluster encourages regional economy, because they use biomass wastes, and that serves instead of importable fuel and that creates new business market. If herewith created infrastructure object – biomass power-plant, - emerges opportunity to additional increase GDP, because companies participate in power-plant projection, construction and installation processes. When the new market is formed and biomass products are sold, the GDF growth rate even more biomass. GDP increase is benefit for country created by clusterization (Kettels et al., 2006).
2. Unemployment reduction. Often prevail regions, where exists long-term unemployment problems. It is so, because big number of unemployed people

are low-qualification workers, who often fail to find any work. Biomass cluster assist in solving this problems, because cluster activity is compatible with unskilled labour force integration for the biomass preparation purpose. When unemployment reduces, emerges opportunity to diversify operative conditions and implements, and to ensure equality of operative conditions (Kettels et al., 2013).

3. Biomass cluster creates national budget income. It is evident through a VAT, engaged employees taxes (income tax, social insurance), also profit tax. Especially increases VAT pickup, because then wood wastes recast to the energy business is formed and reduced energy resources import, increased the transactions numbers within the country and they would be taxable in the same tax, which later gets in to country budget.
4. Changes of import structure. Using own biomass resources drastically reduces county energy import needs, it also reduce gas consumption in towns. It would let to achieve that country foreign trade balance will go to surplus and money which would be gained for reduce of energy import from foreign countries, can be diverted for increase of competitiveness.
5. Strengthening of energy independence. Right now exist such situation, when countries produce energy using gas or coal. Just few countries dispose these resources. If energy production would use local biomass resources, situation would go into the melting-pot and it would let to achieve, that several countries would be externally independent of energy production changes in energy export countries, also for gas supply kinks and politic shading, because country would ensure energy independence.

The benefit of biomass cluster to country economy is fairly clear and versatile. To development of this type of clusters can achieve clear benefit both for particular country, and assessment of macroeconomic standpoint. When analysing opportunities to create biomass cluster, Lithuania was chosen on purpose to explore information, whether it is worth to in establish a biomass cluster a country.

In assessing of differences shown in the variation coefficient, abstracted region, which is constituted by five municipalities. In three municipalities main fuel is biomass wastes.

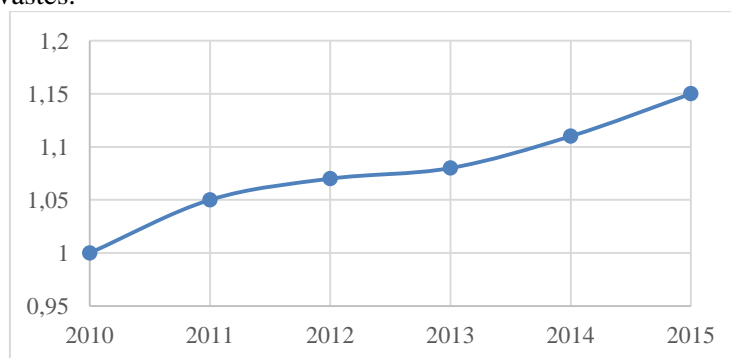


Figure 3. Variation coefficient changes

Main reason of index growth is concerned with the increase of biomass usage in countries regions and intensification of biomass produce companies. Companies which increase their competitiveness, can raise regions comparative indexes. Two municipalities through the analytical period switched to biomass consumption, their regions created new work places and that increased GDP per capita. There is a noticeable tendency of high regional concentration distinction in regions, where forestry level is over 40 %, and dominate fuel type for energy production is biomass. In these regions unemployment level is till 13 % and in many cases is less nor in regions where regional concentration in this sector is low. In this case there is presented example of how where was calculated highest RQ possession in municipality result.

$$LQ = \frac{\frac{E_{ij}}{E_j}}{\frac{E_{in}}{E_n}} = \frac{\frac{131}{6100}}{\frac{10076}{1319000}} = 2,811$$

This municipality is characterized by that its forestry level is 59, 5 %, and dominant fuel type in this region is biomass. This situation shows that the biomass preparation sector employ enough employees and herewith prepared biomass from wastes serves energy needs of municipality. Unemployment level in the region is 12, 7 % (year 2015).

Assessing opportunities to create biomass cluster, it is necessary to assess current usage of biomass and its potential. Practically all of Lithuanian regions have favourable conditions for biomass cluster, because only small part of biomass potential is used. Thus, cluster would not have shortage of fuel for energy production. Even in those regions where are relatively low numbers of forests they are not fully exploited, therefore while using wood wastes it would be possible not only to supply cities with heat energy, but also to produce electricity. In this case, it is based on municipal data which was assessed with regional concentration index.

$$MP = \frac{SP}{SPUG} = \frac{7710000}{70300} = 109,6728$$

Results show, that strategic potential usage degree is not high, however municipality can fully serve their heat energy demand. Given the opportunity, fuel export is possible, which could help to make cluster activity in the region more effective and even more useful for cluster members.

Biomass cluster influence on business competitiveness is obvious, because concentration of resources can improve competitive position in the region and promote regional intensification at economic and social level. Cluster structure lets incessantly collaborate with scientific institutions, whose knowledge and researches can help reduce costs and increase benefit value.

Conclusions and Future Research

This research indicated that biomass clusters influence on business competitiveness is significant, because when resources are concentrated it can enhance economic indexes, and also improve social and environmental situation. Analysis shows, that in Lithuanian case, there are just small part of available reserves used, and biomass cluster assists in retain a lower unemployment level in regions nor in case when regions use import fuel. Biomass cluster model reflects on business compete opportunities – it involves wide amplitude of business subjects from biomass suppliers to final product processors. Together with scientists assistance business competitiveness can be additionally enhance through management level growth and industrial prism. Formulas invoke for research let search in which regions biomass cluster is most required and where it would present biggest benefit while combining different resources, with which organization is disposing. This allows investors to analyse regions faster and this helps to carry out investment decisions. Cluster model let's create a structure which is capable to provide region with necessary energy for bottom price while employing local citizens and creating new economic value. In the future research where are likely wider research on biomass cluster influence on business competitiveness, emphasizing cluster variety and opportunity to get financial benefit from different business ranges.

References

- Anbumozhi V., Gunjima T., Prem Ananth A., Visvanathan C., 2010, *An assessment of inter-firm networks in a wood biomass industrial cluster: lessons for integrated policymaking*, "Clean Technologies and Environmental Policy", 12(12).
- Bernat A. G., 1999, *Industry clusters and rural labor markets*, "Southern Rural Sociology", 15(1).
- Delgado M., Porter M.E., Stern S., 2010, *Clusters and entrepreneurship*, "Journal of Economic Geography", 10(4).
- Delgado M., Porter M.E., Stern S., 2014, *Clusters, convergence, and economic performance*, "Research Policy", 43(10).
- do Carmo Farinha L.M., de Matos Ferreira J.J., Borges Gouvei J.J., 2014, *Innovation and competitiveness: a high-tech cluster approach*, "The Romanian Review Precision Mechanics, Optics & Mechatronics", 45(45).
- Francescato V., Negrin M., 2013, *The cluster of biomass producers, Italian biomass association (AEIL)*, <http://www.congresobioenergia.org/ponencias/AIEL.pdf>, Access on: 12.09.2016.
- Hämäläinen S., Näyhä A., Pesonen H.L., 2011, *Forest biorefineries – A business opportunity for the Finnish forest cluster*, "Journal of Cleaner Production", 19(19).
- Ketels C., Lindqvist G., Sölvell O., 2006, *Cluster initiatives in developing and transition economies*, Stockholm, Center for Strategy and Competitiveness.
- Ketels C., Lindqvist G., Sölvell O., 2013, *The Cluster Initiative Greenbook (2 edition)*, Stockholm, Ivory Tower Publishers.
- Krioukov A., Alspaugh S., Mohan P., Dawson-Haggerty S., Culler D. E., Katz R.H., 2012, *Design and Evaluation of an Energy Agile Computing Cluster*, *Electrical Engineering*

- and Computer Sciences, Technical Report No. UCB/EECS-2012-13, University of California.
- Lechner C., Leyronas C., 2012, *The competitive advantage of cluster firms: the priority of regional network position over extra-regional networks – a study of a French high-tech cluster*, "Entrepreneurship & Regional Development", 24(5–6).
- McCauley S.M., Stephens J.C., 2013, *Green energy clusters and socio-technical transitions: analysis of a sustainable energy cluster for regional economic development in Central Massachusetts, USA*, "Sustainability Science", 7(2).
- Porter M.E., 2000, *Location, Clusters and the "New" Macroeconomics of Competition*, "Economic Development Quarterly", 14(1).
- Porter M.E., 1998, *On competition*, Cambridge, MA, Harvard Business School Press.
- Vaz T.D.N., Nijkamp P., 2008, *Knowledge and innovation: The strings between global and local dimensions of sustainable growth*, "Entrepreneurship & Regional Development", 21(4).

WPLYW KLASTRA BIOMASY NA KONKURENCYJNOŚĆ GOSPODARCZĄ

Streszczenie: Głównym problemem prezentowanym w artykule jest istnienie w dzisiejszym świecie konieczności zapewnienia alternatywnych źródeł energii, która nie degradowałaby środowiska i nie ograniczyła zasobów światowych. Klastry biomasy mogą pomóc w urzeczywistnieniu tego założenia, promując w ten sposób konkurencyjność i wzrost gospodarczy. Celem artykułu jest stworzenie modelu klastra biomasy, który może być konkurencyjny na rynku energetycznym. W literaturze naukowej funkcjonowanie klastrów biomasy i ich wpływ na konkurencyjność przedsiębiorstw są stosunkowo mało zbadane. W sektorze energetycznym procesy klasteryzacji odbywają się w oparciu o użyteczność rodzajów paliw, zastosowanie dla nich technologii, a następnie poszukiwanie konsumentów energii. Autorzy artykułu rozwijają problematykę klasteryzacji, wpływu na metodologię konkurencyjności oraz sugerują, aby analizować wpływ klasteryzacji jako odrębny przypadek na podstawie przypadku Litwy. Obliczenia pokazują, że działalność klastra jest ukierunkowana na wykorzystanie odpadów drzewnych, a to pozwala osiągnąć korzyści gospodarcze, społeczne i środowiskowe. Z rozwoju skorzystają nie tylko członkowie klastrów, ale także konkurencyjność kraju, ponieważ silny lokalny biznes zapewnia pozytywny wpływ na krajową gospodarkę.

Słowa kluczowe: konkurencyjność, klastry biomasy, klasteryzacja

生物群落對商業競爭力的影響

摘要: 本文研究的主要問題是，今天的世界，提供替代能源是必要的，不會破壞環境，保護有限的世界資源。生物質的集群可以幫助實現，從而提高業務競爭力和增長。本文的目的

創建一個在能源市場上具有競爭力的生物質群模型。在科學文獻中，生物質集群的運作及其對企業競爭力的影響相對較小。在能源領域，集群化過程通過可用的燃料類型運行，為其應用技術，然後尋求能源用戶。論文作者發展集群化對競爭力方法論的影響，提出集群化影響分析的案例。在分析懸而未決的地區，援引立陶宛的情況。計算表明，集群活動面向木材廢物的使用，這可以實現經濟，社會和環境效益。經濟增長不僅是集群成員，也是國家競爭力，因為強大的本地業務為國家經濟提供了積極的影響。

關鍵詞: 競爭力，生物量聚類，聚類