Romanian Biotechnological Letters *Vol. 18, No. 6, 2013*

ORIGINAL PAPER

Green energy from agriculture and Romanian firms' competitive advantage

Received for publication, September 16, 2013
Accepted, October 3, 2013

IONICA HOLBAN[1], CARMEN-MIHAELA BOTEANU[2], MARIUS PETRESCU[3]
[1]*Tomis University from Constanta, Faculty of Economic Studies*
100 Petru Vulcan Street, 900628 Constanta, Romania
Corresponding author: *E-mail: ionicaholban@yahoo.ro*
[2]*Valahia University from Targoviste*
2 Carol I Street, 130024 Targoviste, Romania
E-mail: carmenboteanu@yahoo.com
[3]*Valahia University from Targoviste*
2 Carol I Street, 130024 Targoviste, Romania
E-mail: marius.petrescu@orniss.ro

Abstract

The concept of green energy from agriculture has been widely discussed in recent times, but the questions of how a company can implement a green energy project using renewable resources from agriculture and diversify into other business operations and of whether choosing such an approach will translate into an competitive advantage for the company have yet to be in-depth examined. This study approaches the topic of green energy produced using renewable resources from agriculture, and in particular the biomass while considering two important issues related to the implementation of these types of projects, namely, pollution prevention and product stewardship. Against this background, we consider the outcomes of a case study (respectively a survey conducted between January 2013 and March 2013 with interviewees from 430 Romanian companies) and provide the resulting conclusion and recommendation for future studies. The tendencies in Romania, as well as, all over the world are of intensifying the efforts for promoting the energy based on regenerating resources from agriculture.

The structure of this paper is as follows: first, we discuss the environmental aspects of the Natural Resource-Based View theory and the literature related to green energy from agriculture, the Romanian companies competitive advantages that may be generated by the implementation of green energy projects and formulate our propositions. Secondly, we evaluate the implications for research and practice. Finally, we close the paper by providing the conclusions and recommendations for future studies.

Keywords: green energy from agriculture, biomass, pollution prevention, product stewardship, competitive advantage, environmental sustainability

Introduction

The recent emergence of cost effective equipment directed towards energy efficiency has been regarded as a social and technical arena of innovation (Davidson & al. 2011). The researchers distinguish between technical innovations (those that involve new technologies, products and services) and administrative innovations (those that involve procedures, policies and organizational issues) (Tarafdar & Gordon 2007). Traditionally, there have been high costs associated with the management of most agricultural residues, and therefore, they have not been yet widely used for energy purposes. While renewable energy approaches tend to focus more towards administrative issues and on the framework for promoting the usage of green energy, we also consider that the technological aspects are also to be considered by the practitioners in the agriculture science area. Environmental capability is on-going in operations management, marketing, and strategy, and although this is still a nascent area, a number of interesting findings have already emerged (Hart & Dowell 2010). Still, discussions on environmental capability in environmental sustainability context have been rather scarce to date. It is therefore important to shed light on the application of the environmental capability in the green energy field and to place it in the agricultural context.

Agricultural biomass is a relatively broad category of biomass that includes the food-based portion of crops (such as corn, sugarcane, or beets), the non-food-based portion of crops (such as corn stover, leaves, stalks, cobs, orchard trimmings, husks etc), perennial grasses, and animal waste. Strictly by-products of agricultural biomass include straws, sunflower stalks, soy straw, leaves (beet), pods (soy beans), shells (walnuts, hazelnuts), seeds (plum, peach, apricot) and manure from livestock. However, all these can offer significant biomass resource, if technology and infrastructure are developed to economically recover and deliver this type of biomass to processing facilities. One should discuss the green energy potential based on agricultural renewable resources from the Natural Resource-Based View theory perspective and suggest activities in order to achieve this potential. The Natural Resource –Based View theory approach is that a competitive advantage can be sustained only if the capabilities creating the advantage are supported by resources that are not easily duplicated by competitors. In other words, it is likely that strategy and competitive advantage in the coming years will be rooted in capabilities that facilitate environmentally sustainable economic activity – a natural resource based view of the firm. (Hart, 1995). From this perspective, in accordance with the Natural Resource-Based View theory, a company that possess resources of biomass, is able to achieve a competitive advantage in comparison with the competition, and can ensure its superior long-term performance (Barney 1991; Grant 1991).

Advances in recent years have shown that there are even more efficient and cleaner ways to use biomass. It can be converted into liquid fuels (ethanol, butanol) or combustible gases (methane, hydrogen), using fermentation technologies which reduces emissions produced from biomass combustion. Also, biomass production is an area booming due to increased interest in alternative energy sources. The use of energy from biomass is successfully applied in several countries with large populations in Asia. The most applied technology for biomass processing is anaerobic digestion for biogas production. For example, in China over 10 million such facilities are operated, providing up to 80% of the electricity required in rural areas. The process called "Global Gas Scheme" has been used in India for over 75 years, and is being applied in over 80.000 installations currently in operation. Large rural areas in India rely mostly on energy from biomass (including firewood, animal dung, and agricultural residues) for cooking, heating, and lighting, duet o the difficult access to other energy sources.

According to a survey of the US Energy Information Administration, India also uses biomass in the power sector. According to the Ministry of New and Renewable Energy, in India are operating 288 cogeneration plants using biomass as feedstock, totalling 2.7 GW installed capacity. The potential for electricity generation from biomass can reach the capacity of 18 GW. A large amount of biomass used for electricity generation comes from bagasse (crushed sugarcane or sorghum stalks), which can be used in combustion-powered generators (US Energy Information Administration survey, 2013).

Further, as a result of the investigations and experiments made during the Second World War by the French scholars Ducellier and Isman in Algeria, thousands of farms equipped with such "*Ducellier - Isman systems*" have also appeared. *Ducellier and Isman systems* consists mainly in processing of residual biomass by a technology based on multi-chamber fermentor, where the pressure of the biogas generated can drive the liquid into a tank located on a higher level and pressure being abruptly eliminated, when it reaches a predetermined limit, by the action of an automatic valve, thereby enabling the liquid to flow, by gravity, from the tank into the lower chamber. As the valve is automatically closed, the same phenomena recur and so determine a pulsating circulation, the pulsation periods being controlled by the action of the automatic valve. A feature of their process was that agricultural waste was first pretreated by aerobic fermentation before being digested. Another feature of aerobic pre-digestion was that a certain amount of heat was generated (Van Brakel, 1980) Germany initiated a large-scale bio processing plant development, where agricultural waste and by-products are processed in order to produce biogas and bio-fertilizer.

Past practice of uncontrolled waste causing negative environmental effects are no longer acceptable today. Even garbage storage platforms or incineration of organic waste is no longer consider to be a best practice by today's standards as environmental protection requirements have become more stringent now, while energy recovery and recycling of nutrients and organic matter is now more than ever necessary. In other words, achieving more with less is the new standard in terms of sustainable development. Biogas production through anaerobic digestion (AD) is considered to be the optimal treatment for manure, and of a wide variety of organic wastes suitable for this purpose, are converted into renewable energy and organic fertilizer for agriculture. At the same time, removing the organic fraction from the total waste, increases the energy conversion efficiency of the remaining waste used in incineration process on one hand and the waste dump stability on the other hand.

Currently, the most important application of AD processes are in biogas production technologies, by processing substrates from agriculture, animal manure, crop residues, energy crops and organic wastes from agro-industrial activities in the food industry. According to the International Energy Agency (IEA), a number of thousands of agricultural plants using AD are operational in Europe and North America. Many of these plants are large scale systems, technologically advanced and their number increased considerably in recent years. In Germany alone, more than 3.930 biogas plants were operating in 2010. In Asia, several million small scale digesters are in operation in countries such as China, India, Nepal and Vietnam, producing biogas used mainly as fuel for cooking and lighting. It is estimated that Europe has considerable potential to increase current production of biogas on livestock-related activities (IEA, http://www.iea.org/media/ieajournal/IEAEnergy_Issue2.pdf). Strong arguments indicating the use of green energy from biomass are the positive effects on the environment and socio-economy, on employment and labor stabilization of farmers in areas with rich biomass resources that can be used for energy production.

In Romania, the National Energy Development Strategy has among its objectives the use of efficient and safe clean technologies, based on renewable energy resources, and among these biomass is considered a priority.

Biotechnologies applied for biofuels production are currently developed around the world. The central point of these biotechnologies is the use of microorganisms as bio-catalysts to perform conversion of biomass into ethanol, methane, butanol and other bio-constituents as energy carriers or bio-polymers. It is widely accepted that the biomass is the largest renewable energy source and will play an important role in European and global energy markets. The role of biomass energy resource becomes more important in the context of the future economic development strategies and for achieving the European energy target of 20% renewable energy generated by renewable resources by 2020. In 2010, the biomass provided about 6 % of total energy consumption in EU 27 and in countries such as Finland, Sweden and Austria biomass provides 15 to 20% according to Eurostat data (Share of renewables in gross inland energy consumption, 2010). Biomass can play a significant role in ensuring the energy independence of countries with high biomass production potential. The use of biomass takes place on two levels, namely for power and heat cogeneration plants and as a feedstock in the production of biofuels. Biotechnologies developed for production of second generation biofuels have successfully tempered the food versus fuel debates. In Romania agricultural residues represent a great potential for renewable energy production. Vintilă et al., reported in 2011 that by conversion into biogas of residues generated in Romanian agriculture and households, 75% from the national electricity consumption can be covered if the whole residual biomass potential will be used. In another study, the same author develops new biotechnologies for conversion of lignocellulosic residues to ethanol as second generation of biofuels.

A further important issue debated in this context of green energy produced by using biomass, is pollution prevention (Russo & Fouts 1997; Christmann 2000; King & Lenox 2002; Cai&Chen 2012). Pollution prevention refers to efforts to reduce, change, or prevent emissions and effluent discharges through better usage of resources, materials substitution, recycling, or changes in the production process (Stead & Stead 1995; Willig 1994). Pollution prevention, which seeks to prevent waste and emissions rather than cleaning them up “at the end of the pipe”, is associated with lower costs. In other words, by enforcing pollution prevention policy a company may have lower costs by avoiding the risks and higher costs generated by an environmental incident. For example, removing pollutants from the production process can increase efficiency by: (a) reducing the inputs required, (b) simplifying the process, and (c) reducing compliance and liability costs (Hart & Dowell 2010). This strategy is people-intensive and it depends upon tacit skill development through employee involvement and work in "green" teams (Hart 1995). The important variable ‘product stewardship’ has been also examined already in several studies (Pujari & al. 2003; Fowler & Hope 2007; Cai&Chen 2012; Christina & al. 2011) approaching the applicability of the concept of product stewardship and pollution prevention in the green energy from agriculture context. For example, an Oak Ridge National Laboratory (ORNL, http://bioenergy.ornl.gov/papers/wagin/index.html) study found that farmers could grow 188 million dry tons of switch grass on 42 million acres out of the total agricultural land of approximately 430 million acres in the United States at a price of less than $50 per dry ton delivered. This level of production would increase total U.S. net farm income by nearly $6 billion, which is significantly higher that the revenues generated from the existing agricultural uses of this agricultural cropland. ORNL also estimates that about 150 million dry tons of corn stover and wheat straw are available annually in the United States at the same price, which could increase farm income by another $2 billion. This assumes that about 40 percent of the total residue is collected and the rest is left to maintain soil quality.

Materials and methods

While many researchers use different terminology to address environmental sustainability, this study pleads for the term of “green energy from agriculture”. This is due to the energy efficient biomass resources which are highly related to environmental improvement objectives represented by the term ‘green’. Green energy from agriculture capability could be defined as a company’s ability to deploy renewable energy resources towards energy efficiency and environmental sustainability. The implementation framework of a green energy project consists of four layers, namely: strategy & planning, process management, people & culture and governance. First, the layer of strategy & planning include the specific objectives that the company envisages by the use of biomass from agriculture and how these objectives comply with the organization’s overall sustainability strategy, objectives, and goals. Second, process management capability includes the sourcing, operation, and disposal of management systems, as well as the provision of systems based on sustainability objectives and the reporting of performance. Thirdly, the human resources and organizational culture capability defines a common approach which is used by the employees while they adapt to the new sustainability principles, as the company implements a green energy project. Finally, there is the governance capability, which develops common and consistent policies and requires accountability and compliance with relevant regulation and legislation (Donnellan & al. 2011). This framework is used to measure the capability maturity of a company. There is growing evidence that competitive advantage often depends on the firm's superior deployment of capabilities (Christensen & Overdorf 2000). Porter (1980) makes the distinction between cost and differentiation advantages, which has previously been used to classify types of competitive advantages created by firms' environmental strategies (Shrivastava 1995). The implementation of a green energy project can translate into a cost advantage for the company in comparison with its competitors and may include also the adoption of other best practices such as redesigning production processes to be less polluting, substituting less polluting inputs, recycling by-products of processes, and innovating less polluting processes (Christmann 2000). From this perspective a company will be better placed to meet the sustainability standards in the future. Differentiation advantages include the main benefits associated to an environmental differentiation strategy in terms of the firm's environmental reputation, increased sales or environmental innovation (Carmona-Moreno & al. 2012).

Loeser & al. (2011) suggested that by implementing consistent green energy from agriculture initiatives, cost and differentiation advantage can be created.

In accordance with the results in green energy from agriculture and the prominence of social, economic, and ecological significances triggered by green energy from agriculture, the question of how Romanian companies active in the field of agriculture assess their capability in green energy from agriculture projects becomes particularly relevant.

Of major importance for this study are the ways in which green energy technologies can be promoted in companies with available resources of biomass, particularly by two approaches: pollution prevention and product stewardship to further enhance company's competitive advantage.

The pollution prevention capability can support the reduction of the environmental impact of the company by using residual biomass and can help managers to position biomass technologies applications as environmental tools across business processes. The product stewardship (biomass management) helps managers to supervise the life cycles of the product in accordance with environmental preferences. This approach will make biomass a significant contributor towards company's environmental sustainability.

Against this background, the survey instrument used for this study was as a combination of a questionnaire survey and research interviews. The type of questionnaire is a self-administered one and it included a short glossary explaining the purpose of the survey. The questionnaire is divided into three parts and has a total of 45 questions focusing on followings:

P1: pollution prevention using biomass can significantly affect a Romanian firm's competitive advantage

P2: product stewardship using biomass can significantly affect a Romanian firm's competitive advantage.

In order to collect the sample data, interviewees from a number of 430 Romanian agri-food companies companies (agricultural holdings, livestock farms, processors) were contacted by phone or email between January 2013 and March 2013. The answers were provided by the top managers of the companies out of which around three quarters of the interviewed companies are agricultural operations. 340 companies replied to a questionnaire while 90 companies were interviewed directly.

Results and discussions

Drawing upon the answers, we pictured ways in which green energy produced from biomass might be achieved particularly via the pollution prevention and product stewardship to further enhance a firm's competitive advantage.

The results of the survey are summarized in the two tables below:

Table 1. Answers regarding pollution prevention using biomass. Main advantages perceived at company level

Pollution prevention using biomass which can significantly affect a company competitive advantage by:	Questionnaire Results		Interview Results	
Increase of energy efficiency	185	54,41%	40	44,44%
Increase of the impact of environmental policies and reducing the marginal costs of environmental policies	74	21,76%	20	22,22%
Reducing emissions of gas with greenhouse effects	58	17,06%	14	15,56%
Waste reduction	23	6,76%	16	17,78%
Total	340	100%	90	100%

Table 2. Answers regarding the product stewardship using biomass. Main advantages perceived at company level

Biomass ***product stewardship*** can significantly affect a company competitive advantage by:	Questionnaire Results		Interview Results	
Increase of energy efficiency	243	71,47%	53	58,89%
Increase of the impact of environmental policies and reducing the marginal costs of environmental policies	51	15,00%	16	17,78%
Reducing emissions of gas with greenhouse effects	34	10,00%	14	15,56%
Waste reduction	12	3,53%	7	7,78%
Total	340	100%	90	100%

As it can be seen from tables 1 and 2, biomass brings a large number of socio-economic benefits (as over 70% of the companies who provided answers view the usage of biomass as an approach to increase energy efficiency) both for firms directly involved in its production and for the society as well with significant contributions to greenhouse gas emissions reduction. Due to the increasing impact of environmental policies, the usage of biomass for energy production is considered to be a priority by the Romanian companies.

Intrinsic valorisation of the technological chain of biomass production enhances local economic efficiency increases the impact and reduces the marginal costs of environmental policies (also provides employment in rural areas and increases regional purchasing power). This leads to a further conclusion of the study which is that the use of biomass will improve the living standards and contributes to the social development of the whole society as a whole, but also to the economic development, for all those engaged in agricultural activities.

Regarding the resources of available biomass with energy potential in Romania:

- the richest counties in agricultural resource are Timis – 1.432 thousand tons, Calarasi - 934 thousand tons, Braila, 917 thousand tons;
- the poorest in this type of resource are the counties Harghita – 41.004 tons, Covasna – 73.000 tons and Brasov – 89.000 tons.

By analysing the results of the survey, one can observe that the use of biomass as a renewable energy source generates benefits at agricultural, environmental and economic level for farmers, employees in the biomass facilities and society as a whole by ensuring:

- Inexpensive and environmentally low-risk recycling of manure and organic waste;
- Production of renewable energy;
- Reduction of emissions of gas with greenhouse effects ;
- An enhanced veterinary safety, by sanitation of digestate;
- An improved fertilization efficiency;
- Fewer inconveniences caused by odours and insects.
- Economic benefits for farmers.

Conclusions

One of the major conclusion of the study is that biomass plays an important role due to the increased interest for the use of renewable energy sources, with a very high potential for development as more and more companies take into consideration the use of biomass for energy production. The benefits of using biomass for energy generation are multiple, and can translate into a reduction of the energy bills for the agri-food companies or can generate additional sources of income for the company as beneficiary of the support schemes currently in place for the green energy, in case they decide to require authorization for energy production. Also, by implementing a green energy project a company is better prepared to mitigate the effects of the ever more stringent environmental requirements. At farm level, the use of biomass can be a source of diversification of activities generating more income. In addition, the product stewardship can improve the life cycle of green products in line with the environmental requirements which also lead to Romanian's companies competitive advantage. The results of the survey show that there is a clear perception at the level of the companies that usage of biomass in green energy projects can serve as a differentiation factor that can offer a competitive advantage. Also, the usage of residual biomass is perceived as being an effective tool for achieving energy efficiency and compliance with the ever more stringent environmental standards.

Romania has great potential in relation to the production of energy from sources such as agricultural residues and waste, but these practices (if not done in an environmentally proper manner) could lead to increased erosion and soil depletion. It is necessary to identify effective measures in order to combat the risks raised by intensification of agriculture, such as planting energy crops or implementation of soil protection measures.

Further research should continue to scientifically test these hypotheses and investigate other relationships as hypothesized in the theory such as the association between pollution prevention and product stewardship in the context of green energy from agriculture. Such studies could uncover further interesting interactions and enrich our understanding of these two concepts (pollution prevention and product stewardship) in the actual context.

References

1. ARAGÓN-CORREA, J. A., HURTADO-TORRES, N., SHARMA, S., GARCÍA-MORALES, V.J., Environmental strategy and performance in small firms: A resource-based perspective. *Journal of Environmental Management, 86*(1), 88-103, (2008).
2. BACHOUR, N., CHASTEEN, L., *Optimizing the Value of Green Energy from agriculture Projects within Organizations.* Paper presented at the Green Technologies Conference, (2010).
3. BARNEY, J., Firm Resources and Sustained Competitive Advantage. *Journal of Management, 17*(1), 99-120, (1991).
4. CAI, S., CHEN, X., BOSE, I., The many faces of Green Energy from agriculture. *International Journal of Business Data Communications and Networking, 8*(2), 52-59, (2012).
5. CARMONA-MORENO, E., CÉSPEDES-LORENTE, J., MARTINEZ-DEL-RIO, J., Environmental human resource management and competitive advantage. *Management Research: The Journal of the Iberoamerican Academy of Management, 10*(2), 125-142, (2012).
6. CHRISTENSEN, CLAYTON., OVERDORF MICHAEL., Meeting the challenge of disruptive change, *Harvard Business Review,* (2000).CHRISTINA, W.Y.W., KEE-HUNG, L., KUO-CHUNG, S., CHIN-SHAN, L., T.K.P.LEUNG. (2011). Gr*een operations and the mo*derating role of environmental management capability of suppliers on manufacturing firm performance. *International Journal of Production Economics, doi:10.1016/j.ijpe.2011.08.031*.
7. CHRISTMANN, P., Effects of "Best Practi*ces" of Environmental Management on Cost Advantage: The Role of Complementary* Assets. *The Academy of Management Journal,* 43(4), 663-680, (2000).
8. DAVIDSON, E., VAAST, E., WANG, P., The capabilities of market-driven organizations. *Journal of Marketing,* 58(4), 37, (2011).

9. EUROSTAT, Share of renewables in gross inland energy consumption, 2010, http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdcc110
10. FOWLER, S. J., HOPE, C., A Critical Review of Sustainable Business Indices and Their Impact. *Journal of Business Ethics,* 76(3), 243-252, (2007).
11. GRANT, R.M., The resource-based theory of competitive advantage: implications for strategy formulation. *California Management Review, 33* (3), 114–135, (1991).
12. HART, S. L., A Natural Resource Based View of the Firm, *Academy of Management Review,* 20(4), 986-1014, (1995).
13. INTERNATIONAL ENERGY AGENCY, Renewable Energy: Coming of age. *The Journal of International Energy Agency*, Issue 2 (2012). http://www.iea.org/publications/freepublications/publication/IEAEnergy_Issue2.pdf
14. HART, S.L., DOWELL, G., A Natural-Resource-Based View of the Firm: Fifteen Years After. *Journal of Management,* (2010).
15. KING, A., LENOX, M., Exploring the Locus of Profitable Pollution Reduction. *Management Science,* 48(2), 289-299, (2002).
16. LOESER, F., EREK, K., SCHMIDT, N.-H., ZARNEKOW, R., KOLBE, L. M., *Aligning Green Energy from agriculture with Environmental Strategies: Development of a Conceptual Framework that Leverages Sustainability and Firm Competitiveness*. Paper presented at the Americas Conference on Information Systems 2011. Retrieved from http://aisel.aisnet.org/amcis2011_submissions/222, (2011).
17. MOLLA, A., COOPER, V., Green Energy from agriculture Readiness: A Framework and Preliminary Proof of Concept. *Australasian Journal of Information Systems 16*, (2009).
18. PARKER, C.M., FRAUNHOLZ, B., ZUTSHI, A., How do Australian Small And Medium Enterprises Communicate their Environmental Improvement Activities Online? *Australasian Journal of Information Systems, 17*(1), (2010).
19. PORTER, M. (1980). *Competitive strategy*. New York: Free Press.
20. PUJARI, D., WRIGHT, G., PEATTIE, K., Green and competitive: Influences on environmental new product development performance. *Journal of Business Research, 56*(8), 657-671, (2003).
21. RUSSO, M.V., FOUTS, P.A., Resource-Based Perspective on Corporate Environmental Performance and Profitability. *Academy of Management Journal, 40*(3), 534-559, (1997).
22. SCHMIDT, N.H., EREK, K., KOLBE, L. M., ZARNEKOW, R., Examining the Contribution of Green Energy from agriculture to the objectives of it Departments: Empirical Evidence from German Enterprises. *Australasian Journal of Information Systems, 17*(1), 127-140, (2010).
23. SCHMIDT, N.H., EREK, K., KOLBE, L.M., ZARNEKOW, R., *Towards a Procedural Model for Sustainable Information Systems Management*. Paper presented at the 42nd Hawaii International Conference on System Sciences, (2009).
24. SHRIVASTAVA, P., The role of corporations in achieving ecological sustainability. *Academy ofManagement Review, 20*(4), 936-960, (1995).
25. STEAD, W.E., STEAD, J.G. (Eds.), *An empirical investigation of sustainability strategy implementation in industrial organizations*. Greenwich, CT: JAI Press, (1995).
26. TARAFDAR, M., GORDON, S.R., Understanding the influence of information systems competencies on process innovation: A resource-based view. *The Journal of Strategic Information Systems, 16*(4), 353-392, (2007).
27. US Energy Information Administration, *Independent Statistics and Analysis*, *Countries-India*, (2013), http://www.eia.gov/countries/cab.cfm?fips=IN.
28. VAN BRAKEL, J, Biogas before 1970: a review. *Delft University of Technology, 1980.*
29. VINTILA, T., NEO, S., Biogas in Romanian Agriculture, Present and Perspectives. Scientific Papers Animal Sciences and Biotechnologies Vol. 44 (1), (2011).
30. VINTILA, T., VINTILA, D., NEO, S., TULCAN C., HADARUGA N., Simultaneous hydrolysis and fermentation of lignocellulose versus separated hydrolysis and fermentation for ethanol production. Romanian Biotechnological Letters Volume: 16 Issue: 1 Supplement: S, (2011).
31. VYKOUKAL, J., BECK, R., WOLF, M., Impact of Pressure for Environmental Sustainability on Grid Assimilation – Empirical Results from The Financial Services Industry. *Australasian Journal of Information Systems 17*(1), (2010).
32. WALKER, H., BRAMMER, S., The relationship between sustainable procurement and e-procurement in the public sector. *Int. J. Production Economics, 140*, 256–268, (2012).
33. WALSH, E. MARIE., GRAHAM L.ROBIN., Economic Analysis of Energy Crop Production in the U.S. -- Location, Quantities, Price and Impacts on Traditional Agricultural Crops. *Oak Ridge National Laboratory*, 1998, http://bioenergy.ornl.gov/papers/wagin/index.html
34. WILLIG, J.T.E., *Environmental TQM*. New York: McGraw-Hill, (1994).