



Entrepreneurship in Central and Eastern Europe: Case studies in Biomass Energy Production

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Abstract

Research on the diffusion of renewable energy technologies in CEE has emphasised the enhancement of related entrepreneurial activities as one of the most important elements for the development and diffusion of renewable energy. This deliverable aims at deepening our understanding of the factors triggering entrepreneurship in the production of energy from biomass in Central and Eastern Europe. The hypothesis is that from an innovation systems perspective entrepreneurship is driven by complementarities arising from the favourable interaction of three types of opportunities in the system: Technological Opportunities (TO), Market Opportunities (MO) and Institutional Opportunities (IO).

The study develops a case study analysis to explore to which extent these opportunities are conducive to Knowledge Intensive Entrepreneurship defined in terms of growth, innovation and knowledge intensity of the production processes. The results suggest that Technological Opportunities (TO) are especially conducive to innovation and growth in terms of sales in biomass energy production. Moreover, for the cases under consideration, Market Opportunities (MO) can trigger growth in sales even if Technological Opportunities (TO) are low, at least in the short-term. Nonetheless, Market and institutional opportunities (MO and IO) cannot compensate for low Technological Opportunities (TO) to induce innovation.

The main policy implication of the multiple case study analysis is the need to promote technological opportunities in the bioenergy field in CEE countries. Actors seem to benefit from domestic and foreign demand triggering growth. Nonetheless, at the current stage of technological development, this demand led growth in the bioenergy sector does not induce innovation. The ability of CEE companies to introduce new technologies and apply knowledge intensive technologies is constrained by missing technological opportunities. Policy instruments targeting the supply of research and development and human capital seem necessary. Moreover, the institutional framework seems to need further alignment with the entrepreneurial necessities of the actors in the bioenergy field, especially in terms of regulations.

1. Introduction

This deliverable aims at deepening our understanding of the factors triggering entrepreneurship in the production of energy from biomass in Central and Eastern Europe.

Biomass energy production (i.e. bioenergy) involves the production of energy from biomass. European Directives define Biomass as: “the biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste” (European Parliament 2009). Biomass can be converted to provide energy in the form of electricity, heat and fuel for transportation. Biomass is the biggest source of renewable energy, on a final energy consumption basis. In 2009, renewable energy from biomass and waste accounted for the largest share in total renewable energy (around 70 %). The main source of biomass is agriculture followed by forestry and industry. In 2009 wood and wastes represented the bulk of biomass and wastes used for renewable energy, followed by municipal wastes (Eurostat 2010).

A number of studies have analysed the potential for biomass production in Central and Eastern European (CEE) economies and the prospect for bioenergy production in these countries. Van Dam et al. (2007) assessed the availability of land for energy crop production in CEE countries, the total biomass production potential (including agricultural residues and forest residues) and production costs for selected energy crops (willow, miscanthus, sugar beet and rapeseed) for the CEE countries as a whole. Their results suggest that biomass can be produced at lower costs in CEE countries than in Western European countries and even compete in terms of costs with fossil oil. The countries with the largest land areas such as Poland and Romania have the highest biomass potentials. This high-potential and competitiveness of Biomass from CEE bring about a significant export potential for CEE economies. In their study of the biofuel sector in East Europe, Kondili and Kaldellis (2007) identify very good prospects for Biofuel development and exports in the Czech Republic and in Poland while in Hungary efforts will be required to develop the sector. Not only the economic potential of bioenergy is a matter of inquiry in current research, also the ecologic and environmental impact of bioenergy is being analysed. Focusing their study on Bulgaria and Romania and on the former soviet republics in central Asia Srebotnjak and Hardi (2011) develop economic and ecological indicators to conclude that Bulgaria and Romania have the potential of developing sustainable bioenergy markets and, as a result of their EU accession, their infrastructure and political conditions are favourable. Indeed, in CEE countries the realisation of bioenergy potential in depends to a large extent on the effectiveness of the implementation of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources (European Parliament 2009). Nonetheless, research on the diffusion of renewable energy technologies in CEE has emphasised the enhancement of related producers as one of the most important elements for the development and diffusion of renewable energy (Patlitzianas et al 2007; Patlitzianas and Karagounis 2011). Patlitzianas and Karagounis (2011) assess the Political (and legal forces), the Economical forces, Sociocultural forces, and Technological forces shaping the business activities of renewable energy producers. To them these forces are determinant for the success of renewable energy producers.

To study the entrepreneurial activities in the production of energy from biomass this deliverable takes an innovations systems perspective. Following Radošević and Yoruk (2013) the deliverable

assumes “entrepreneurial activities and entrepreneurial propensities of the innovation system are not only derived from the behaviour of enterprising individuals but also from the structure of entrepreneurial opportunities and activities in the innovation system” (Radošević and Yoruk 2014, p. 1016). Accordingly, the hypothesis is that in an innovation system entrepreneurship is driven by complementarities arising from the favourable interaction of three types of opportunities in the system: Technological Opportunities (TO), Market Opportunities (MO) and Institutional Opportunities (IO). In the absence of one of these, entrepreneurial opportunities cannot be realised. From this perspective, the deliverable applies case study analysis focusing on four companies from the biomass energy production sector in Central and Eastern Europe. Based on questionnaires completed by company managers, the case studies derive a qualitative assessment of how Technological Opportunities (TO), Market Opportunities (MO) and Institutional Opportunities (IO) shape the entrepreneurial processes of the companies in biomass energy production.

The next section presents the methodological approach. Section 3 develops the individual case studies based on a common questionnaire and presents the qualitative assessment of how different opportunities shape knowledge intensive entrepreneurship (KIE). Section 4 focuses on a multiple case study analysis and derives conclusions.

2. Methodology

The deliverable collects data from 4 companies involved in the production of energy from biomass. The four companies were selected from the Amadeus database after conducting desk research and considering these common characteristics:

- The company was established after 1990,
- The company is located in a central or eastern European country,
- The company’s main business activity is active in the value chain of producing energy from biomass,
- The company is experimenting growth in terms of sales in the period 2009-2013.

Drawing on Yin (2009) the analysis develops case study analysis to explore to which extent Technological Opportunities (TO), Market Opportunities (MO) and Institutional Opportunities (IO) are conducive to Knowledge Intensive Entrepreneurship. Knowledge Intensive Entrepreneurship is identified in terms of growth, innovation and knowledge intensity of the production processes. First the deliverable includes four single case studies which are further considered in a multiple case study analysis to elaborate general heuristics of the influence of the different opportunities on the entrepreneurial activities considered.

To capture the nature the entrepreneurial activities and the opportunities triggering them we use the questionnaire elaborated by Radošević and Yoruk (2014). Drawing on the questionnaire indicators for the different dimensions of KIE, TO, MO and IO for each company have been derived. Table 1 gives the indicators for each dimension analysed and the questions of the questionnaire used to derive the indicators.²

Table 1. Indicators used and related questions from the questionnaire

Index	Sub-index	Component	Indicators at firm level	Question
Index of Knowledge Intensive Entrepreneurship (KIE)		New enterprises	-Factors effecting entrepreneurial activity -Net entry rate	Q.18
		Economic Performance	-Sales growth rate during the last five years -Employment growth rate during the last five years	Q.6 Q.5
		New technology, innovation and knowledge intensity	-Number of innovations during the last three years -Patents granted -Trademarks granted -ISO9001, 14001 certificates -Royalty and license fees receipts (% of turnover) -Production process sophistication	Q. 9 Q. 10 Q.12 Q. 20.1
Index of Knowledge Intensive Entrepreneurial Opportunities IKIEO = TO + MO + IO	Technological Opportunities ITO = RND + SKILL + KNWK	Knowledge development and diffusion	-R&D expenditures (% in turnover) -Royalty and license fees payments (% of turnover) -Availability of latest technologies -Firm-level technology absorption -FDI and technology transfer -Capacity for innovation	Q. 16 Q. 17 Q.20.1 Q.20.2 Q.20.3 Q.20.4
		Competence building in skills	-Number of employees (with PhDs, master's, Graduates) -R&D personnel (% in total employment) -Engineers (% in total employment) -Quality of the educational system -Quality of math and science education -Local availability of specialized research and training services -Extent of staff training -Brain drain	Q.5 Q.17 Q.17 Q.21.1 Q.21.2 Q.21.3 Q.21.4
		Knowledge and value chain networks	-Importance of cooperation partners in innovation activity -Value chain breadth -Local supplier quantity -Local supplier quality -University-industry research collaboration -Availability of scientists and engineers -Quality of scientific research institutions	Q.22

² The questionnaire is included in the annex.

	Market Opportunities IMO = DEMAND + FINANCE	Demand side activities	-Share of exports in turnover -Foreign market demand -Domestic market demand -Buyer sophistication: buyer's purchasing decision -Type and importance of customers	Q.6 Q.8 Q.23 Q.24
		Financing of innovation processes and other activities	-Kind of funding received for a particular research project and its importance -Ease of access to loans -Venture capital availability	Q.27
	Institutional Opportunities IIO = REGULATION + SUPPORT	Regulatory environment	-Burden of government regulation -Efficiency of legal framework -Transparency of government policymaking -Strength of auditing and reporting standards -IPR protection	Q.28
		Public support to incubating & other supporting activities	-State of cluster development -Favouritism in decisions of government officials -Wastefulness of government spending -Government procurement of advanced technology products -Opportunity to sell new products in public tenders	Q.26

Source: based on Radošević and Yoruk (2014)

According to information available for all companies and using the information for each component as organised in table 1 to derive the indicators, the case studies follow a uniform framework. After a brief description of the activities of the company and general information of the company regarding year of establishment and number of employees, the individual case studies focus on the following dimensions which match to a large extent the components included in Table 1:

1. Knowledge Intensive entrepreneurship (KIE)

1.1. sales growth,

1.2. innovation

1.3. type of technology and/or production methods (knowledge or labour intensive)

2. Technological Opportunities (TO)

2. Knowledge development and diffusion

2.1. Competence building and Skills

2.2. Knowledge and Value Chain networks

3. Market opportunities (MO)

3.1. Demand Side Activities

3.2. Finance

4. Institutional opportunities (IO)

4.1. Regulatory Environment

4.2. Public Support

Each dimension within the three types of opportunities receives an assessment in terms of “Low”, “Medium” or “High”. This is a qualitative assessment considering the answers to questionnaires. They include mostly questions to be answered with a scale from 1 (worst) to 7 (best).³ Answers in the range 1-2 are labelled as “low”, in the range “3-5” as medium and in the range “6-7” as high. These assessments are used for the multiple case study analysis.

3. Individual Case Studies in Energy from Biomass in CEE

This section presents the individual case studies.

3.1. Company 1

Company 1 is a private and independent company established in 2005. The company had 80 employees in 2013. The business is focused on crop breeding (*Miscanthus sinensis*), supply of propagation material, agriculture-technology consulting, development of biomass projects and advisory and training services in its fields of expertise.

Knowledge Intensive Entrepreneurship: Fast growth with low innovativeness and labour-intensive technology

The company experienced static growth in terms of sales in the start-up phase (5 years after establishment) and very fast growth in the period 2008-2013. Its innovation performance in the period 2008-2013 was weak. Its main innovation was a product innovation introduced in the start-up phase of the firm (between 2005-2007). It was a product new to the firm but not new to the sector. The company conducts design activities, it has not filed any patents and does not hold any quality management system certification. According to its own assessment, the company carries out labour-intensive methods of production.

Technological Opportunities

- Knowledge development and diffusion: Low Technological Opportunities

The company is a technology adopter carrying research activities in the adoption process. According to its own assessment it has a good ability to adopt and apply mature technologies in its field. Technological risk and the lack of technological know-how represent to a certain extent an obstacle for the entrepreneurial activity of the firm. This perception adds to a missing organizational unit for conducting research and development in the company. Nonetheless systematic research and development activities in the adoption process do exist. These indicators suggest *low exploitation of technological opportunities* in what concerns knowledge development and diffusion.

- Competence building in skills: Low Technological Opportunities

To a certain extent the difficulty in finding employees with technical skills is considered a hurdle for the entrepreneurial activities of the firm. According to the company specialized research and training services in the bioenergy field are not available. The educational system is not considered supportive

³ See Annex for the questionnaire and the scales available in each question.

at all with regard to raising skills in the bioenergy field. The employees of the firm do not have a university degree. The company has a fair commitment to train and retain employees and is able to retain them.

These indicators suggest *low exploitation of technological opportunities* in what concerns competence building in skills.

- Knowledge and value chain networks : Medium Technological Opportunities

According to the company finding network partners is a strong hurdle for the activities of the company. In the country of location there is a number of research institutions and universities related to the bioenergy field. Scientists with expertise in fields related to the operations of the company exist. In what concerns suppliers for potential collaborative activities they exist and their quality is moderate. The most important partner of the company is a university. The company holds a long term research and development agreement with it. These indicators speak for *medium exploitation of technological opportunities* in what concerns knowledge and value chain networks.

Market Opportunities

- Demand Side Activities: Medium Market Opportunities

Large firms together with SMEs are the most important customer groups of company 1. Their purchasing decisions are based on both, lower prices and performance attributes of the products. The firm sells its high technology products almost exclusively in the foreign market. In 2012 the share of exports in the turnover was 90%. Demand and market constraints are considered strong obstacles in the entrepreneurial activity of the firm. Competition and barriers of entry created by large companies represent obstacles to a certain extent. These indicators suggest a *medium exploitation of market opportunities* arising from the demand.

- Finance: Low Market Opportunities

Company 1 relies largely on family funding, own financial resources and European Funds to cover its financial needs. The start-up phase was financed through own capital (60%), venture capital (20%) and EU funding (20%). Company 1 considers that in the country the availability of venture capital for risky investments in the field is rather weak. Large sunk investments and funding constraints represent important obstacles for the entrepreneurial activity of the firm. These indicators suggest *low exploitation of market opportunities* enabled by finance.

Institutional Opportunities

- Regulatory Environment: Low institutional opportunities

The company's assessment of the regulatory environment suggests that regulatory framework conditions are not supportive for the economic activities. The company considers complying with administrative requirements (permits, regulations, reporting) issued by the government as very burdensome. Moreover, the firm does not feel good informed at all by the government of changes in policies and regulations affecting the bioenergy field. In what concerns intellectual property protection and anti-counterfeiting measures the company considers their enforcement is very weak. The exploitation of institutional opportunities enabled by the regulatory environment is low.

- Public Support: Low institutional opportunities

The company considers that public investment with regard to bioenergy technologies does not provide necessary goods and services not provided by the market. Public tenders and public

procurement decision do not contribute to technological innovation by the firm or by other firms in the sector. The exploitation of institutional opportunities enabled by the public support is low.

Case study 1: Synthesis

The company is labour intensive experiencing fast growth while not being able to innovate. In what concerns the **technological opportunities**, these are low. The company does not have a clear research and development strategy and does not have access to specialised human capital. Nonetheless it interacts with a university in the framework of a long term research and development agreement. The business is strongly export oriented and is able to exploit export driven **market opportunities**. These market opportunities given by foreign demand seem to compensate for weak public support and legal framework conditions to sustain growth in sales (**low institutional opportunities**). However, the innovation performance remains weak. All in all, market opportunities trigger growth in sales. However, the innovation performance remains weak. This may be due to missing technological opportunities and institutional opportunities.

3.2. Company 2

Company 2 was founded as a private company with limited liability in 2013. The company is independent and has no controlling shareholders. It had 30 employees in 2013. Its main activity is the assembling of boilers and turbines developed and manufactured by suppliers for the use of pomace as fuel for thermal power plants. The company is located in a technology development centre.

Knowledge Intensive Entrepreneurship: Fast growth, low innovativeness, labour-intensive technology

The company has experienced fast growth in terms of sales in the start-up phase (since 2013) and it has had so far a low innovation performance. Its main innovation was a product innovation new to the firm that introduced in the start-up phase of the firm (2013). So far it has not filed any patents or trademarks. It holds an ISO9001 quality management system certification. The technologies adopted and applied are rather labour-intensive technologies.

Technological Opportunities

- Knowledge development and diffusion: low technological opportunities

The company is mainly a technology adopter conducting research only to a certain extent in the adoption process. According to its own assessment, the company has a good ability to adopt and apply technologies. Technology risk represents to a certain extent an obstacle for the entrepreneurial activity and the lack of technological know-how is not considered a hurdle for the entrepreneurial activity of the firm. In what concerns its research and development strategy, the company does not have a research and development unit and does not conduct any structured research and development programs or design activities. These indicators suggest *low technological opportunities* in what concerns knowledge development and diffusion.

- Competence building in skills: Low technological opportunities

In the company 30% of the employees are university graduates holding Master and Bachelor Degrees (1MA and 8BSc). The company has relatively low commitment to train and retain employees. The educational system is not considered supportive with regard to raising skills in the bioenergy field. The company believes that there is room for improvement in the national availability of specialized

research and training services for the field. Nonetheless, the difficulty in finding employees with technical skills is not considered a hurdle for the entrepreneurial activities of the firm. All in all, these indicators suggest low technological opportunities together with low commitment to accumulate of human resources.

- Knowledge and value chain networks: Medium technological opportunities

According to the company, in the country of location research institutions and universities are accessible and scientists with expertise in fields related to the operations of the company exist only to a certain extent. In what concerns the suppliers, availability for collaborative activities and their quality are moderate. Finding network partners is a moderate hurdle for the activities of the company. The most important partners for the company are domestic universities and suppliers. The indicators suggest medium technological opportunities in what concerns knowledge and value chain networks.

Market Opportunities

- Demand Side Activities: Medium market opportunities

Large firms are clearly the most important customer group of the company. Their purchasing decisions are based on the lowest price rather than on a sophisticated analysis of performance attributes of the products. The firm sells its high technology products almost exclusively in the domestic market. Demand, market constraints or competition are not considered obstacles in the entrepreneurial activity of the firm.

- Finance: Medium market opportunities

The company relies on own financial resources, funding from a bank and on European Union funds to cover its financial needs. To establish the company the financial needs were covered by a credit (45%) and own financial resources (45%) and by a development program of the European Commission (10%). The company considers that in the country the availability of venture capital for risky investments in the field is rather weak. Nonetheless large sunk investments and funding constraints do not represent strong obstacles for the entrepreneurial activity of the firm.

Institutional Opportunities

- Regulatory Environment: High Institutional opportunities

The company's assessment of the regulatory environment suggests that regulatory framework conditions fully satisfies the necessities of the company. The company considers complying with administrative requirements (permits, regulations, reporting) issued by the government as not burdensome at all. Moreover, the firm feels very informed by the government of changes in policies and regulations affecting the bioenergy field. In what concerns intellectual property protection and anti-counterfeiting measures the company considers their enforcement is quite good.

- Public Support: Medium Institutional Opportunities

The company assesses public support as satisfactory. Even though the evaluation points out some room for improvement in this concern. The company considers that to a certain extent public investment with regard to bioenergy technologies provides necessary goods and services not provided by the market. The company has never had the opportunity to sell its products through public tenders. However, the company thinks that public procurement decisions contribute to technological innovation by other firms in the sector.

Case study 2: Synthesis

The company is labour intensive experiencing fast growth while not being able to innovate. In what concerns **the technological opportunities**, it does not have a research and development strategy and does not conduct any research. The availability of qualified labor force is not very good and moreover, the company does not engage in human capital. Finding network partners is a moderate hurdle for the activities of the company. **The market opportunities** are shaped by the domestic demand of large firms basing their purchasing decisions on price rather than on quality. The financial needs are satisfied through the banking system and the EC subsidies. These market opportunities given by foreign demand add to a favourable institutional framework. **Institutional opportunities** shaped by a supportive regulatory framework and public policy seem to sustain the growing sales. All in all, market and institutional opportunities trigger growth in sales. However, the innovation performance remains weak. This may be due to missing technological opportunities.

3.3. Company 3

Company 3 is a subsidiary of a global provider of biogas plants active in 22 countries. It was established as a subsidiary in 2006. In 2013 the company had 26 employees. Company 3 develops turn key projects for the establishment of Biogas Plants with the technology developed by the parent company. It is the main subsidiary of the multinational in Central and Eastern Europe. The mother company has its core competences in the development of technologies related to the use of digestate and biogas technologies. To improve the customer service, the company offers the possibility to finance projects of biogas plants partially or even completely. Therefore the parent company runs its private financial institution.

Knowledge Intensive Entrepreneurship: Fast growth, high innovativeness, knowledge intensive technologies.

The company experienced very fast growth in terms of sales in the start-up phase (5 years after establishment) and fast growth in the period 2008-2013. Its innovation performance in the period 2008-2013 was strong. In the start-up-phase (2006-2011) and more recently (2012) the company has been able to introduce innovative products in the market that were new to the world. The company does not conduct any design activities, it has not filed any patents and does not hold any quality management system certification. The company applies knowledge intensive technologies.

Technological Opportunities

- Knowledge development and diffusion.

As a subsidiary it is a technology adopter from the parent company. According to its own assessment, the company has an excellent ability to adopt and apply technologies in its field. The company does not have an organizational unit for conducting research and development. Structured research and development activities are not carried out either, even though research activities do exist in the company. Neither technological risk nor the lack of technological know-how represents an obstacle for the entrepreneurial activity of firm. These indicators suggest *medium exploitation of technological opportunities* in what concerns knowledge development and diffusion.

- Competence building in skills: Low technological opportunities. Strong companies' commitment to accumulate human resources.

65% of its employees are university graduates holding Bachelor, Master and PhD Degrees (5, 8 and 4 respectively). The company has relatively strong commitment to train and retain employees. Nonetheless, it is not able to retain them. The educational system is not consider supportive at all with regard to raising skills in the bioenergy field. The company believes that there is a lot of room for improvement in the national availability of specialized research and training services in the bioenergy field. The difficulty in finding employees with technical skills is considered a hurdle to a certain extent for the entrepreneurial activities of the firm.

- Knowledge and value chain networks: Medium technological opportunities

According to the company, in the country of location there is a lack of research institutions and universities and scientists with expertise in fields related to the operations of the company exist only to a certain extent. In what concerns the suppliers, availability for collaborative activities is moderate and their quality is quite good. Finding network partners is a moderate hurdle for the activities of the company. The most important partners for the company are suppliers. Universities are not part of the collaborative network. Licensing agreements, subcontracting and research and development agreements are the main forms of collaboration.

Market Opportunities

- Demand Side Activities: High market opportunities

SMEs are clearly the most important customer group of the company followed by the public sector. Their purchasing decisions are rather based on a sophisticated analysis of performance attributes of the products. The firm sells its high technology products almost exclusively in the domestic market. Demand, market constraints or competition are not consider obstacles in the entrepreneurial activity of the firm.

- Finance: Medium Market Opportunities

The company relies largely on own financial resources to cover its financial needs. The establishment was financed by the parent company with 90% of the initial resources. The company considers that in the country the availability of venture capital for risky investments in the field is weak. Nonetheless large sunk investments and funding constraints do not represent strong obstacles for the entrepreneurial activity of the firm.

Institutional Opportunities

- Regulatory Environment: High institutional opportunities

The company's assessment of the regulatory environment suggests that regulatory framework conditions satisfy quite well the necessities of the company. The company considers complying with administrative requirements (permits, regulations, reporting) issued by the government as not burdensome. Moreover, the firm feels very good informed by the government of changes in policies and regulations affecting the bioenergy field. In what concerns intellectual property protection and anti-counterfeiting measures the company considers their enforcement is good.

- Public Support: Low institutional opportunities

The company considers that public investment with regard to bioenergy technologies does not provide necessary goods and services not provided by the market. The company has had the opportunity to sell its products through public tenders. However, public procurement decisions do not contribute to technological innovation by the firm or by other firms in the sector.

Case study 3: Synthesis

The company is a subsidiary of a global provider of biogas plants applying knowledge intensive technologies. The company has experienced fast growth and is a strong innovator. The **technological opportunities** are very high. Even though the company does not have a research and development strategy nor a R&D unit it conducts research and is able to adopt and apply new technologies in the bioenergy field. The company seems to benefit from the organizational capabilities of the parent company. The lack of qualified labor force is compensated through a strong commitment to train and retain employees. The company builds a collaborative network with suppliers through licensing agreements, subcontracting and research and development agreements. The **high market opportunities** are shaped by the domestic demand of SMEs and the public sector. Moreover, the parent company provides financial support. Finally, the **Institutional opportunities** present a mixed picture. They are high in terms of regulatory framework. The company feels the regulations are adequate, well enforced and it feels good informed. Nonetheless, public support is rather ineffective for the necessities of the company.

3.4. Company 4

Company 4 was founded as a private limited liability company in 1998 as engineering and consulting company. The company had 3 employees in 2013. Its economic activity is the supply of complete systems for the production of pellets and briquettes from agricultural waste. Since 2007, the company provides complete lines and equipment for the production of solid fuels based on biomass, as well as low-power cogeneration systems. The company is the exclusive European supplier of two plant and system manufacturers. The latest product supplied by the company is a mobile system for the production of pellets from biomass and plant waste.

Knowledge Intensive Entrepreneurship: Stable growth, high innovativeness, knowledge intensive technology

Company 4 experienced very fast growth in terms of sales in the start-up phase (1998-2003) and stable growth in the period 2008-2013. Its innovation performance in the period 2008-2013 was strong. In the startup-phase (1998-2003) it was able to introduce two product innovations new to the country. In the more recent period (2008-2013) the company has continued to introduce product and process innovations new to the firm and new to the country. The company has filed a patent application and conducts design activities. The technologies are knowledge intensive frontier technologies.

Technological Opportunities

- Knowledge development and diffusion: high technological opportunities.

The company adopts technology by licensing or by imitating technologies from foreign companies. According to its own assessment, the company masters the adoption and application of frontier process technologies in its field. It does not have an organizational unit for conducting research and development, however systematic research and development activities do exist. In 2013 one employee was conducting research and development activities. Neither technological risk nor the lack of technological know-how represent an obstacle for the entrepreneurial activity of your firm. These indicators suggest *high exploitation of technological opportunities* in what concerns knowledge development and diffusion.

- Competence building in skills: Medium technological opportunities. Strong commitment to accumulate human resources

The three employees hold a university degree: two employees with a MS degree and one employee with a PhD. The company has a strong commitment to train and retain employees and is successful at it. The educational system is consider supportive with regard to raising skills in the bioenergy field. However, the company still finds room for improvement in the national availability of specialized research and training services in the bioenergy field. The difficulty in finding employees with technical skills is a hurdle for the entrepreneurial activities of the firm.

- Knowledge and value chain networks: Medium technological opportunities

According to the company, in the country of location research institutions and universities are accessible and scientists with expertise in fields related to the operations of the company exist. In what concerns the suppliers, availability for collaborative activities and their quality are weak. Finding network partners is a strong hurdle for the activities of the company.

The most important partners for the company are foreign customers and suppliers. Universities are not part of the collaborative network. Strategic alliances and subcontracting are the main forms of collaboration.

Market Opportunities

- Demand Side Activities: Medium market opportunities. Foreign orientation.

Large firms followed by Small and Medium Enterprises (SME) are the most important customer groups of the company. Their purchasing decisions are largely based solely on the lowest price. The firm sells its high technology products almost exclusively in the foreign market. In 2012 the share of exports in the turnover was 90%. Demand or market constraints are not consider obstacles in the entrepreneurial activity of the firm. Rather competition and barriers of entry created by large companies represent obstacles for the firms.

- Finance: Low market opportunities

The company relies on a broad set of financial sources to conduct its activities (own financial resources, funding from a bank, public funding from national government or local authorities, European Union funds, R&D tax incentives). Specially own financial sources and European Union funds are the main financial bases of the company. The company considers in the country there is not access to venture capital for risky investments in its field. Funding constraints represent strong obstacles for the entrepreneurial activity of the firm.

Institutional Opportunities

- Regulatory Environment: Low institutional opportunities

The company's assessment of the regulatory environment suggests that regulatory framework conditions do not satisfy the necessities of the company. On the one hand, complying with administrative requirements (permits, regulations, reporting) issued by the government is evaluated as very burdensome. Moreover, the firm does not feel clearly informed clearly by the government of changes in policies and regulations affecting the bioenergy field. In what concerns intellectual property protection and anti-counterfeiting measures the company considers their enforcement very weak.

- Public Support: Low institutional opportunities

The company evaluates public support as not very supportive for its economic activities. The company considers that investment with regard to bioenergy technologies does not provide necessary goods and services not provided by the market. The company thinks that public tenders and public procurement decisions do not contribute to technological innovation in the sector.

Case study 4: Synthesis

The company has experienced stable growth and is a strong innovator. It applies and develops knowledge intensive technology. The **technological opportunities are high**. The company masters the adoption and application of frontier process technologies in its field and carries out systematic research and development activities. All employees hold a university degree and the company has a strong commitment to train and retain them. Moreover, the educational system is consider supportive with regard to raising skills in the bioenergy field. Finding network partners is a strong hurdle for the activities of the company. The most important partners for the company are foreign customers and suppliers. These high technological opportunities (except for the opportunities of knowledge and value chain networks) are complemented with **rather weak market and institutional opportunities**. The company is clearly export oriented. It considers the regulatory environment as not satisfactory for its necessities and public support is rather ineffective for the necessities of the company.

4. Multiple Case study Analysis in Energy from Biomass in CEE

This section considers the 4 individual case studies simultaneously departing from the categories and the analysis already developed in the individual case studies above. Table 2 presents these items.

Table 2. Multiple Case Study Analysis

		Company 1	Company 2	Company 3	Company 4
KIE	Sales Growth*	Very Fast	Fast	Fast	Stable
	Innovativeness	Low	Low	Very High	High
	Technology Type	Labour Intensive Technology	Labour Intensive Technology	Knowledge Intensive Technology	Knowledge Intensive Technology
TO	Knowledge development and Difussion	Low	Low	Medium	Medium
	Competence building in skills	Low	Low	Low	Medium
	Knowledge and value chain networks	Medium	Medium	Medium	Medium
MO	Demand	Medium	Medium	High	Medium
	Finance	Low	Medium	Medium	Low
IO	Public support	Low	Medium	Low	Low
	Legal framework/ regulations	Low	High	High	Low

*During the last 5 years: 2009-2013

KIE: Knowledge Intensive Entrepreneurship; TO: Technological Opportunities; MO: Market Opportunities, IO: Institutional Opportunities.

The 4 case studies can be group in two categories: companies with a high Knowledge Intensive Entrepreneurship (Innovative, Growing and Knowledge Intensive activities) and companies with weak KIE (labour intensive mature technologies experimenting growth).

In what concerns the companies with knowledge intensive entrepreneurship, companies 3 and 4 have high levels of innovativeness, adopt knowledge intensive technologies and grow either at a fast or at a stable rate in terms of sales. Interestingly, both companies have relatively high technological opportunities. They conduct research and are able to adopt and apply new technologies in the bioenergy field. Moreover, both companies have a more or less strong commitment to train and retain employees and complement their capabilities with networks for collaboration. Market opportunities are also available at least to a certain extent. Company 4 has a strong export orientation and company 3 supplies domestic SMEs and the public sector. Market and technological opportunities are not complemented with institutional opportunities. Especially in the case of company 4 public support and legal framework conditions are not effective for the necessities of the company. Technological opportunities (TO) and Market Opportunities (MO) seem to be triggering innovativeness, knowledge intensity and sales growth despite low institutional opportunities. Both types of opportunities (TO and MO) might even reinforce each other. The low Institutional Opportunities may constrain KIE. Nonetheless, the effect of IO remains unclear.

On the other hand, companies 1 and 2 have a low level of innovativeness, their activities involve mature labour-intensive technologies and grow fast in terms of sales. Medium levels of Market Opportunities (MO) seem to trigger sales growth in companies 1 and 2. Company 1 is strongly export oriented and company 2 finds a strong demand from domestic large firms. Company 2 also benefits from a quite supportive legal framework, regulations and public policy. However, market opportunities (together with institutional opportunities in the case of company 2) do not seem to drive innovation. Accordingly, case studies 1 and 2 suggest that missing technological opportunities (such as missing in-house research and development strategy, lack of qualified labor force and engagement in accumulating human capital and missing network partners for building knowledge and production networks) result in poor innovative performance, even if the companies may benefit from strong demand and also grow in terms of sales. Interestingly, Institutional Opportunities (IO) (such as supportive regulatory framework and effective public support) together with Market Opportunities (MO) (in terms of demand and financial resources) do not compensate for low technological opportunities to produce innovation.

5. Conclusions

Central and Eastern European (CEE) economies have strong potential for bioenergy production. Research on the diffusion of renewable energy technologies in CEE has emphasised the enhancement of related producers as one of the most important elements for the development and diffusion of renewable energy. The aim of this deliverable is to deepen our understanding of the factors triggering entrepreneurship in the production of energy from biomass in Central and Eastern Europe. The deliverable takes an Innovation Systems (IS) perspective to explore the complementarities arising from the favourable interaction of three types of opportunities in the system: Technological Opportunities (TO), Market Opportunities (MO) and Institutional Opportunities (IO). Based on questionnaires completed by company managers, the deliverable carries out a case study analysis on four companies to derive a qualitative assessment on how Technological Opportunities (TO), Market Opportunities (MO) and Institutional Opportunities (IO) shape Knowledge Intensive Entrepreneurship in biomass energy production in CEE.

The multiple case analysis suggests that Technological Opportunities (TO) are especially conducive to innovation and growth in terms of sales in biomass energy production. Moreover, for the cases under consideration, Market Opportunities (MO) can trigger growth in sales even if Technological Opportunities (TO) are low, at least in the short-term. Nonetheless, Market and institutional opportunities (MO and IO) cannot compensate for low Technological Opportunities (TO) to induce innovation. Finally, Market Opportunities (MO) and Technological Opportunities (TO) possibly intensify each other to trigger Knowledge Intensive Entrepreneurship. The extent to which Institutional Opportunities (IO) may reinforced Technological (TO) and/or Market Opportunities (MO) remains unclear.

The main policy implication of the multiple case study analysis is the need to promote technological opportunities in the bioenergy field in CEE countries. Actors seem to benefit from domestic and foreign demand triggering growth. At the current stage of technological development, this demand led growth in the bioenergy sector does not induce innovation. The ability of CEE companies to introduce new technologies and apply knowledge intensive technologies is constraint by missing

technological opportunities. Policy instruments targeting the supply of research and development and human capital seem necessary. Moreover, the institutional framework seems to need further alignment with the entrepreneurial necessities of the actors in the bioenergy field, especially in terms of regulations.

6. Literature

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Annex: Questionnaire⁴

⁴ The Questionnaire was developed by Radosevic, S. and Yoruk, E. (2014)

EU FP7 Project GRINCOH - Growth-Innovation-Competitiveness: Fostering Cohesion in Central and Eastern Europe _ Questionnaire

Name of the firm:

Name and job title of the interviewee:

Date of interview:

Country of the firm:

1. What is the foundation date of your firm?

2. If your company grew out of another pre-existing organization, how would you characterize the company's relation with the organization of origin currently?

... Corporate spin-out

... University spin-off

... Partner

... Competitor

... Customer

... None of the above. It's an independent company/start-up.

3. Where is your firm located?

... Science/Technology Park

... Incubating Centre/ Technology Development Centre

... Industrial Cluster specific to sector my firm operates in

... Industrial Cluster open to any kind of firm

... None of the above. Independent location.

4. Please estimate the percentage of funding coming from the following sources for starting/establishing your company.

Own financial resources (own savings)	
Funding from family member	
Funding from previous employer (corporate venturing, university incubator technology transfer)	
Business angel	
Venture capital	
Funding from a bank (please specify) _____	
Public funding from national government or local authorities (programs supporting entrepreneurship, etc.) - loan	
Public funding from national government or local authorities (programs supporting entrepreneurship, etc.) – grant	
European Union funds (programs supporting SMEs, etc.)	

Other sources (please specify)	
TOTAL	100%

5. Please fill in the table below about the employees in your firm (full time equivalents).

	Total number of employees	Number of employees with university diplomas (college, BSc)	Number of employees with Master's degrees (MSc or MA)	Number of employees with PhD degrees
At the start of your firm				
5 years after establishment of your firm				
Currently				

6. Please estimate the scale of growth of sales of your company.

	Total growth during the first 5 years after establishment	Total growth during the last 5 years	Annual growth from 2012 to 2013
Very fast (more than 20%) ($x > 20\%$)			
Fast (between 10 and 20%) ($10\% < x \leq 20\%$)			
Slow (between 2 and 10%) ($2\% < x \leq 10\%$)			
Static (between minus and plus 2%)($-2\% < x \leq 2\%$)			
Declining (below minus 2%) ($x \leq -2\%$)			

7. Please state the number of innovations (i.e. new products/processes/services) introduced onto the market by your firm. Please differentiate between whether they have been new-to-firm, new-to-country or new-to-world.

	During the first 5 year period after establishment			During the last 5 year period			In 2012		
	New-to-firm	New-to-country	New-to-world	New-to-firm	New-to-country	New-to-world	New-to-firm	New-to-country	New-to-world
Number of new products									
Number of new processes									
Number of new services									

Note for Q.7: An **innovation** is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organisation or external relations.

8. What is the share of exports in your turnover?

During the last 5 years	In 2012

9. How many patents/trademarks/ISO9001 certificates has your firm obtained?

	During the last 5 years	In 2012
Patent applications		
Patents hold		
Trademarks hold		
ISO9001 certificates hold		

10. Does your firm conduct design activities? Yes ... No ...

An engineering **design** process is the formulation of a plan to help an engineer at the shop-floor to build a product with a specified performance goal. This process involves a number of steps, and parts of the process may need to be repeated many times before production of a final product can begin.

11. What is the main source of design activity conducted? Please tick as appropriate.

Customers' designs ...

Other companies' designs ...

Company's own design ...

Other (please specify) ...

12. What is the average share of **income** from licensing (and royalties) or other form of intellectual assets in your total revenues during the last 5 years? ...%.

13. What is your average share of **payments** for licensing (and royalties) or any other form of intellectual assets in your total revenues during the last **5** years? ...%

14. Is there a research and development (R&D) unit in your firm? Yes ... No ...

R&D unit is the unit in the firm where the primary function is to conduct research and engineering prototype applications with the sole aim to develop new products and new processes.

15. If there is not an R&D unit, is there a systematic and periodically reconsidered R&D programs/projects to produce new products/processes/services? Yes ... No ...

16. Please estimate the share of R&D expenditures in total sales of your firm.

	During the last 5 year period	In 2012
Share of R&D expenditures in your turnover/sales		

17. Please give information about the R&D personnel (as full time equivalent) employed in your firm.

	Total number of R&D personnel	Total number of engineers
At the start of your firm		
Currently		

Note: The number of **R&D personnel** involves full and part time employees, however, no internships, leasing workers or temporary personnel.

18. Can you estimate approximately how many new firms started operations in your technology field in your country and how many firms closed down during **the last year**?

Estimated number of new firms established

Estimated number of firms closed down

19. Please evaluate the extent to which the following factors create obstacles in the entrepreneurial activity of your firm:

1=not at all/ 7=to a great extent

	1	2	3	4	5	6	7
Technology risk							
Large sunk investment (Capital stock in which we have invested has limited flexibility – i.e. we cannot serve a sufficiently diversified customer base using this equipment)							
Funding constraints							
Demand or market constraints							
Marketing problems (i.e. lack of marketing and management know-how)							

Lack of technological know-how							
Difficulty in finding partners for technological collaboration (i.e. joint product production, technical assistance, etc.)							
Difficulty in finding employees with technical skills							
Difficulty in keeping employees with technical skills							
Competition and barriers of entry created by large companies (i.e. MNEs)							
Other (please specify)							

20. This question is about technology issues in your firm. Please evaluate the extent (in a scale of 1 to 7) for each statement below.

	1	2	3	4	5	6	7
In your firm, production processes used are (1 = labour-intensive methods or previous generations of process technology, 7 = the world's best and most efficient process technologies)							
Your firm is (1 = not able to absorb new technology, 7 = aggressive in absorbing new technology)							
If your firm is in a joint venture with a foreign firm or has a foreign partner (i.e. a parent firm, sister firm), your foreign partner (1 = brings little new technology into your firm, 7 = is an important source of new technology for your firm)							
Your firm obtains technology (1 = exclusively from licensing or imitating foreign companies, 7 = by conducting formal research and pioneering their own new products and processes)							

21. This question refers to human skills and training. Please evaluate the extent (in a scale of 1 to 7) for each statement below.

	1	2	3	4	5	6	7
The educational system in your country specifically with regard to raising skills in your technology field (1 = does not meet the needs of a competitive economy, 7 = meets the needs of a competitive economy)							
In your country, specialized research and employee training services particularly in your technology field are (1 = not available, 7 = available from world-class local institutions)							
The general approach of your firm to human resources is (1 = to invest little in training and employee development, 7 = to invest heavily to attract, train, and retain employees)							

Your firm's talented people (1 = normally leave to pursue opportunities in other firms, 7 = almost always remain in the firm)								
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22. This question is about knowledge networks and the supply chain. Please evaluate the extent (in a scale of 1 to 7) for each statement below.

	1	2	3	4	5	6	7
R&D collaboration between your firm and local universities is (1 = minimal or nonexistent, 7 = intensive and ongoing)							
Scientific research institutions related to your technology field (e.g. university laboratories, government laboratories in your country) are (1 = nonexistent, 7 = the best in their fields internationally)							
Scientists and engineers related to your technology field in your country are (1 = nonexistent or rare, 7 = widely available)							
Local suppliers in your technology field in your country are (1 = largely nonexistent, 7 = numerous and include the most important materials, components, equipment, and services)							
The quality of local suppliers in your technology field in your country is (1 = very poor, 7 = very good)							
If your firm is exporting, you are (1 = primarily involved in individual steps of the value chain, e.g., resource extraction or production, 7 = present across the entire value chain, e.g., do not only produce but also perform product design, marketing sales, logistics and after-sales services)							

23. This question is about your innovation collaboration activities. Please evaluate the importance of the following types of partners for your firm in collaborating specifically to introduce new products /processes /services onto the market. Please fill in the below matrix using a scale from 1 to 7. (1=not important, 7=very important). Please also state whether the partners are of domestic or foreign origin.

	Origin of partner		Type of co-operation						
	Domestic	Foreign	Strategic alliance	R&D agreement	Technical support	Licensing agreement	Subcontracting	Research contract-out	Other (please specify)
University									
Research institute									
Customer									
Supplier									
Parent/sister firm									
Government									
Consultant									
Other (please specify)									

Notes for Q.23:

Strategic alliance is a formal cooperation relationship between two or more parties to pursue a set of agreed upon goals, while remaining independent organizations. The alliance often involves technology transfer (access to knowledge and expertise), shared expenses and shared risk.

R&D agreement is an agreement between firms to jointly undertake research and development activities, in order to pool know-how and to share the costs and risks of inventing new products.

Technical support is the provision of advice and/or skills in the form of specialist personnel, training, scholarships and grants for research and development.

Licensing agreement is a contractual right agreement that gives someone permission to do a certain activity or to use certain property owned by someone else. Licenses protect proprietary rights in software and other computer products. A license allows an intellectual property rights holder (the "licensor") to make money from an invention or creative work by charging a user (the "licensee") for product use.

Subcontracting is signed between the company and an individual or in many cases a business to perform part or all of the obligations of a contract related to a specific project. The incentive to hire subcontractors is either to reduce costs or to mitigate project risks.

Research contract-out is the process of contracting the research and development business function to an external provider such as a university or a research organization.

24. This question is about the nature of demand and finance availability in your technology field. Please evaluate the extent (in a scale of 1 to 7) for each statement below.

	1	2	3	4	5	6	7
Customers of your firm make purchasing decisions (1 = based solely on the lowest price, 7 = based on a sophisticated analysis of performance attributes)							
Your firm sells its high technology products in the domestic market (1=none, 7= almost all production)							
Your firm sells its high technology products in the foreign market (1=none, 7= almost all production)							
How easy is it in your country for a firm with innovative but risky projects to find venture capital? (1 = impossible, 7 = very easy)							

25. Please evaluate the importance of the following types of customers for your company.

1=not at all/ 7=to a great extent

	1	2	3	4	5	6	7
Large firms							
Small and medium sized firms							
Public sector							
Final consumers (e.g. private households, private consumption)							
Other sources (please specify)							

26. This question is about the extent of public support in your technology field in your country. Please evaluate the extent (in a scale of 1 to 7) for each statement below.

	1	2	3	4	5	6	7
In your country's economy, how widespread are well-developed and deep clusters with regard to your technology field? (1 = nonexistent, 7 = widespread)							
Do firms in your technology field have contacts with government officials in your country? (1 = yes, officials usually favour well-connected firms and individuals, 7 = no, officials are neutral)							
The composition of public investment with regard to your technology field in your country is (1 = is wasteful, 7 = efficiently provides necessary goods and services not provided by the market)							
Have you or companies that you know in your technology field been involved in public tenders to sell your new products? (1 = never, 7 = very often)							
With regard to your technology field in your country, government procurement decisions result in technological innovation (1 = strongly disagree, 7 = strongly agree)							

27. Please evaluate the importance of funding coming from the following sources for financing of innovation activities in your firm.

1=not at all/ 7=to a great extent

	1	2	3	4	5	6	7
Own financial resources (own savings)							
Funding from family member							
Funding from a bank							
Public funding from national government or local authorities (programs supporting entrepreneurship, innovation, etc.) - loan							
Public funding from national government or local authorities (programs supporting entrepreneurship, innovation, etc.) – grant							
European Union funds (programs supporting SMEs, etc.)							
R&D tax incentives							
Other sources (please specify)							

28. This question is about legal framework and regulations in your technology field in your country. Please evaluate the extent (in a scale of 1 to 7) for each statement below.

	1	2	3	4	5	6	7

Complying with administrative requirements (permits, regulations, reporting) issued by the government in your country is (1 = burdensome, 7 = not burdensome)							
Intellectual property protection and anti-counterfeiting measures in your country are (1 = weak and not enforced, 7 = strong and enforced)							
Financial auditing and reporting standards regarding company financial performance in your country are (1 = extremely weak, 7 = extremely strong, the best in the world)							
The legal framework for private businesses to settle disputes and challenge the legality of government actions and/or regulations in your country is (1 = inefficient and subject to manipulation, 7 = efficient and follows a clear, neutral process)							
Are firms usually informed clearly by the government of changes in policies and regulations affecting your technology field in your country? (1 = never informed; 7 = always informed)							

29. Would you like to receive the final report with the results of the survey?

If yes, please give the e-mail addresses for the reports to be sent to: