

Networking for renewables: local resources and innovative technologies in rural development

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Abstract

Many rural-peripheral regions have been caught in a vicious circle of marginalization. The diminishing prospects for financially feasible agri-/silvicultural activities and the lack of alternative jobs cause the emigration of especially the higher qualified active population and this regional brain-drain causes tax revenues to decline. This leads to diminishing infrastructural investments, which in turn, further depletes the region's attractiveness. However, some rural areas may be able to reverse this cycle by innovative restructuring and adaptation to emerging conditions: the renewable energy sector is able to open good prospects in this situation. The main question of my research is: what could be a suitable social (societal-institutional, technological, development-political) framework which can ensure that these potential prospects are actually realised?

The central-eastern part of Finland has encountered these problems. Global changes (internationalisation of the forest industry, rising energy prices, the climate change, and technological innovations) are having a profound effect on this agro-forest economy and society; also, they are stimulating innovation in different ways. This process is embedded in the context that here, forests are not only a main source of income and principal environment of economic activities but also an important and lasting part of regional and cultural identity, social relations and traditions. The social, cultural, economic and environmental conditions and consequences of the recent, globally experienced transformations are interrelated. As a result, many challenges have arisen but also, several opportunities are offered to the actors engaged in regional/local development.

The paper gives a summary of these interrelated processes, a brief review of the significance and recent developments of the wood energy sector in the Finnish region, and a first account on the empirical research carried out in the autumn of 2008. Meanwhile, the focus is on different forms of networking, ranging from business and technological networks to cross-sectoral co-operation and more informal social networks – relating them, as a key finding, to the possible emergence of 'networked peripheries'. A further objective is to propose different applicable analytical tools and methods which are suitable for triangulating research findings, and which I intend to employ in further comparative regional case studies.

Introduction

The broad context of the research is “networked peripheries”, *sustainable socio-economic development in rural areas through networking supported by innovative technologies*. Within this wider theme, I look at the sector of *renewable energy (wood-energy) production and consumption* (which comprise a set of rising and rapidly developing technologies) as one of the potential means of promoting *sustainable development based on local natural resources*. Furthermore, I concentrate on *information processes, innovation and co-operation networks between the different actors engaged in these activities*, and especially the smaller-scale businesses in rural regions. I investigate the role of *information and communication technologies (ICTs)* in making these actor-networks, processes and the diffusion of technological innovations more efficient, and the local/regional renewable energy sector more competitive in semi-peripheral or peripheral areas.

The current significance of the research project is related to its *multidisciplinary* nature and the *confluence of the local and the global*, i.e. the local/global environmental problems, the local adoption of "global technologies" in the form of specific solutions and models. Also, it intends to investigate *the potential dynamics in the position of the non-core geographical areas*, which regions although may vary according to their degree of urbanity, are in a peripheral situation relative to the urban centres and concentrations of wealth production.

The aim of this paper is to summarise the first phase of a case-study research project which investigates the rural development implications of renewable energy production based on local/regional natural resources. The research aims to analyse the co-operation between small and medium sized enterprises (SMEs) working in wood-energy production, as well as relevant non-private actors such as local municipalities and other public organisations, research institutes, and civil organisations in a rural peripheral region. I concentrate on their information, co-operation and mutual learning processes in particular: I pay special attention to how they can exploit the different applications of information and communication technologies (ICTs) for increasing the competitiveness and profitability of their activities.

The region of North Karelia and its wider area, the (not strictly administratively defined) area of Eastern Finland were selected as the primary case-study area for several practical reasons. This is a rural periphery of the country, as well as of the EU, going through significant transformation in the recent decades, it has substantial forest resources, and it has been recently recognised and promoted as a forerunner in wood energy production and use (Mutanen, 2006).¹ Despite the fact that this is a single region in a selected country, global issues and generally relevant complex socio-economic relationships need to be taken into consideration. This paper attempts at identifying and arranging these diverse aspects and their associations in some systematic way.

The emergence of a rural-urban divide in socio-economic development, the metropolitan concentration of capital and human resources, the urgent need to combat climate change, the rising demand for sustainable utilisation of local natural resources, the international arena of the rapidly developing renewable energy sector, as well as the development and spread of technological innovations (in the context of the emerging information society) indicate various fields of interdisciplinary scientific enquiry and global grand challenges, as well as diverse areas of public policy and capital investment that are all closely relevant to this single case. Therefore, to understand the recent processes in Eastern Finland, it is not enough to comprehend the relationship between nature (forests) and society in this region, or to start off from the significance of the forestry industry here. We need also a sufficient understanding of the international and national policy contexts, the convergence and conflicts between different political and policy-related (e.g. energy, environmental, forestry, tourism, social welfare etc.) interests which impel and steer also (among others: wood energy and information-communication) technological development. Furthermore, the energy and the forest sectors, the environmental implications of human activities and economic growth are all operating at the same time on many spatial and administrative scales; local decisions are embedded into and depend on the national and higher levels. In this respect, the case of Eastern Finland will certainly show general features that are likely to be more or less valid to many other rural-peripheral regions in Europe the growths of which are strongly connected to

¹ In later phases of this research project (from the 2nd/3rd year) other rural regions within the EU will be selected

their natural resource bases *and* their innovative capacities.

However, it has to be mentioned that the case study region is in a somewhat unique and advantaged position. It is located in a country which has one of the greatest forest resources in Europe and which is also among the leading countries internationally in several forestry-related industries and R&D lines and regarding the share of renewable energies in national energy consumption. Eastern Finland (and especially its regional centres), occupies a special position within this country considering its experience and know-how in forest management, forest industry and other related branches. Besides continuing long traditions in relevant education, much of the R&D in these fields has recently started to concentrate and accumulate in the bigger towns here reinforcing a specialised regional knowledge cluster. Moreover, with regards to the other technological component this research investigates, innovations in the rural adaptation of ICTs have been also frequent in this part of the world producing successful pilot projects, not to mention the fact that Finland as a whole, has been one of the most successful and inclusive in developing its information society (i.e. it is among the world leaders in the diffusion of ICTs in business, administration and everyday life; Németh, 2009). Therefore, in many ways, the case study region is not in every way, a periphery, but it is a relatively advanced example of rural areas where the regional and local economies have started to integrate on the one hand the new, innovative technologies, and on the other hand, its own traditional values and methods under the stimulating pressures of global transformations. As such, some interesting good practices, pioneer solutions can be reasonably expected from the Eastern Finnish case study.

Figure 1 is an indication of these complex relationships, i.e. between the inseparable systems of nature, society / technology, and economy, or more specifically, regional natural resources, local and global environmental issues, the energy and forest / forestry industrial sectors, and rural development embedded into its societal and technological contexts². *Figure 2* is a somewhat reduced version of this to show the major connections, and to indicate *the four*

for case study where, if possible, more types of renewable energy sources will be represented.

² I use technology here in its broadest sense, the one Castells equates with society: “technology is society...”, “(t)echnology does not determine society: it embodies it. But nor does society determine technological

main themes that will be discussed in some more detail below.

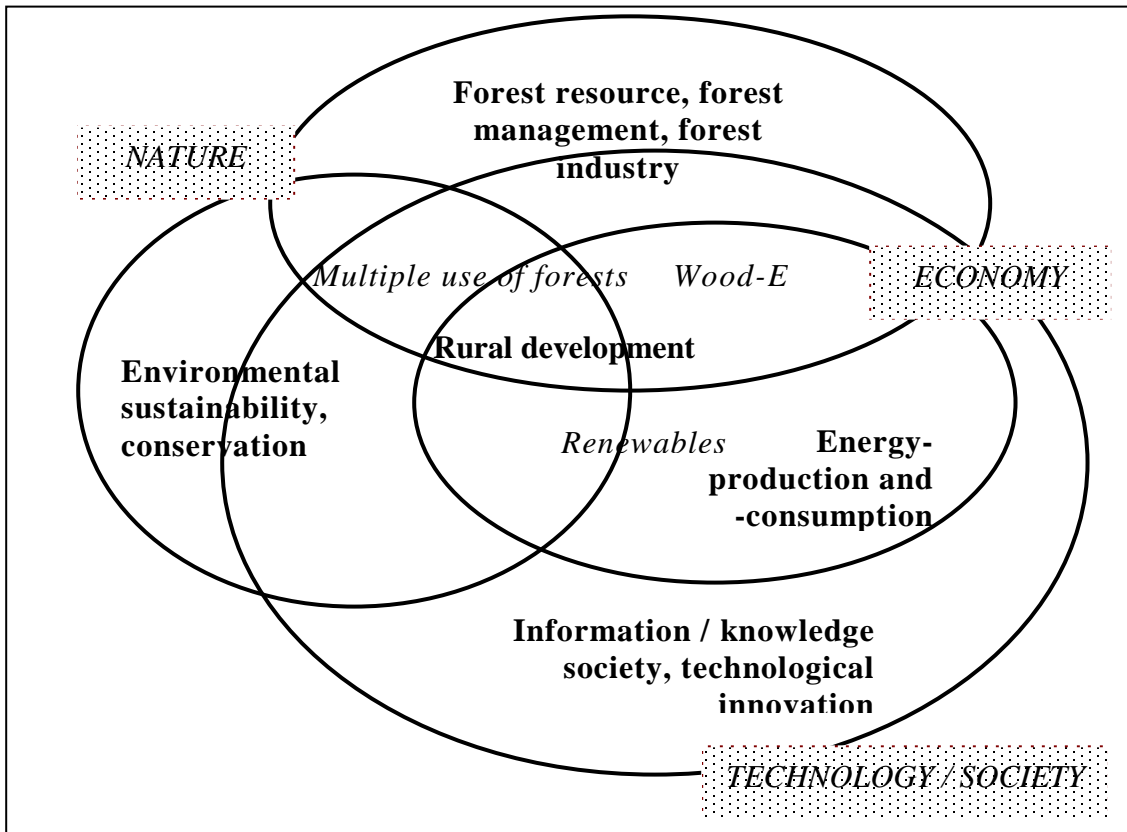


Figure 1. Rural development and wood-energy at the conceptual cross-section of major systems and policy fields

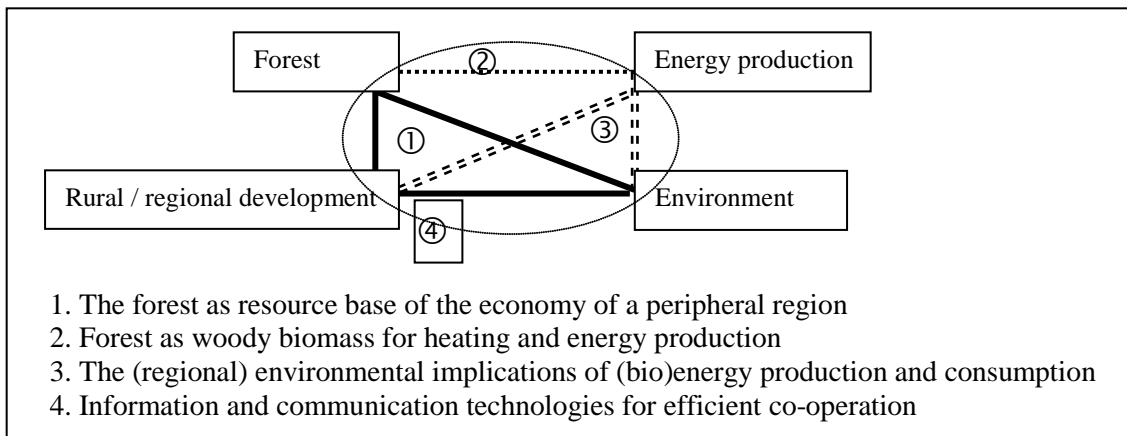


Figure 2. The most important associations explored in the research

1 The forest as resource base of the economy of a peripheral region

First I clarify a few concepts related to forests and natural resources, which are important to define for the purposes of this work.

The *forest resource* is a composition of the biotic and abiotic elements of forests; *forestry* is the management and use of these forest resources including activities such as forest regeneration, silvicultural works, the harvesting of timber and its transportation from the forest to the roadside, as well as nature conservation. The *forest industry*, on the other hand, includes the industries that use wood; these are the pulp, pulp- and paper-product industries, as well as the sawmill industry and furniture production. The activities within forestry and forest industry are referred to together as the *forest sector*.

The *forest cluster* is a group of enterprises in a dynamic interaction which provides clear benefits to all of them, and where the links between enterprises are more important than the differences between them and the various branches they belong to. It can include anything in the forest sector as well as the forestry-related and supporting sectors. These enterprises are connected to each other by the forest resources and *knowledge*. Finally, a *forest industrial community* is a kind of resource community where enterprises of the forest cluster are of significant role in the local economy and social relations; “where the shared interest in the forest business maintains the social network in which they are collaborating” (Hyttinen et al.: 5).

Furthermore, there are two types of natural resources, *stock* and *flow* (Rees, 1985). The former can be consumed by use (such as oil, gas, and coal), theoretically recyclable like elementary minerals, or recyclable, like metallic minerals. On the other hand, flow-type natural resources can regenerate themselves, they are “naturally renewed within a sufficiently short time span to be a relevance to human beings” (ibid. 14). There are some flow-type natural resources which seem to be virtually un-exhaustible, like solar, tidal, wind, wave, geothermic energy, hydropower and air. Some others however, are referred to as *critical-zone natural resources* because their over-exploitation leads to their degradation and

sometimes, extinction: fish, other animals, soils, water and also, forests. While drawing on them as resources, humans have to take into consideration that their physical potential (size of exploitable stock) is moderated by an important constraint: their use has to be allocated over time so that their regenerating ability will be preserved, and future generations be given equal opportunity of their use. Therefore, forest management in Finland, too, has to ensure this sustainability.

Rural-peripheral areas often find themselves caught in a vicious circle where the diminishing prospects for financially feasible agri- and silviculture and the lack of alternative jobs result in the emigration of especially the higher qualified and young population (regional brain-drain), leading to declining tax revenues and therefore, declining infrastructural investments, which further decrease the region's attractiveness for industry and the service sector. Many of the rural-peripheral regions in Europe hold substantial areas of forests, and this natural resource has played an important role in their economies – their regional employment and income – through their multiple use. These forests have also been important for tourism as well as the recreation of the local residents. They have cultural significance in these regions, influencing attitudes, value scales, local-regional identities, and social relationships, and frequently are integral parts of regional and local identities. Therefore, changes that may occur in the role and appraisal of this resource triggered by internal or external processes have a comprehensive impact on the regional society.

Finland has one of the largest forest resources in the European Union. Forests characteristically dominate the landscape, and the forest sector and its supporting branches (e.g. forest machinery manufacturing) have played an especially significant role in economic and social development throughout its history (FFIF, 2000). Also in Eastern Finland, these branches are main employers, and the forest cluster has a substantial impact on public life in general. Therefore, the related social issues are increasingly important here. However, employment in the forest sector has dramatically decreased in the last few decades, and many of the forest industry units (esp. in pulp and paper production) are currently facing closures, too (M.P.K., 2005). This has been happening for various reasons. Finland's extensive forest resource supports particularly large-scale industries in wood processing, where in order to

achieve low production costs and competitiveness, high levels of mechanisation and automation have been implemented. Besides the loss of jobs due to the spread of more mechanised methods in harvesting and transporting wood, drastic cuts in employment in wood processing industries have occurred. Since the 1980s, key players such as the Finnish forest industry groups UPM and Stora Enzo, have internationalised their business and refocused their investments onto emerging markets especially overseas. Operations abroad are set up via corporate acquisitions and by establishing new production sites outside Finland (FFIF, 2000). This means that these companies are gradually downscaling their relatively less profitable domestic capacities, and hence contribute to rising structural unemployment in areas where these economic activities have been traditionally dominant.

It is generally maintained that the future of the forest sector, the forest resource economies and communities depends on a beneficial transformation at both sides of the labour market. It has been observed that the appeal of education and careers in the forest sector has decreased among the young in these regions (FNFP 2015, 2008; M.P.K., 2005), while a growing number of university graduates in other fields often fail to find sufficient jobs even in the provincial centres, and decide rather to move to the southern, core part of Finland. Besides the great responsibility of the education system in training new entrants with better matching qualifications to the newest trends and skill-requirements in the forest sector and related activities, the improvement of the quality of jobs is crucial, too, such as the introduction of more competitive wages, attractive training and career prospects, versatile work, as well as a good working environment and safety. The profitability of forestry requires some boost that would make it a more attractive occupation (FFIF, 2007). Also according to international expert opinion, the forest and wood energy industry will be able to contribute to rural development more if smaller-scale entrepreneurship is promoted, i.e. those which aim to offer higher quality and higher added value, non-traditional goods and services relying on the forest resource instead of capital intensive modes of production, and importantly, demand for resources and supply of new jobs locally/regionally (FNFP 2015, 2008; Okkonen, 2006). A more versatile utilisation of the forest, that is, both its wood and non-wood resources and connected services may result in new enterprises and more attractive jobs. Therefore it is understandable that much emphasis have been laid in Europe – and in Finland – on the

development of small- and medium-scale forestry and forest industrial enterprises to create additional and more diverse employment and income possibilities in the forest sector in these regions (Hyttinen et al.: 3).

2 Forest as woody biomass for heating and energy production

One of the alternative uses of the forest resource is for energy and heat production purposes. Naturally, firewood has been for centuries extracted from the forests in these regions; however, this traditional use was pushed to the background due to more urbanised lifestyles, by large-scale and centralised heating and electricity networks fed by power plants usually operating on fossil fuels or nuclear power. Despite this tendency, technological development (more efficient burners, stoves and filters, new methods of processing raw wood into more convenient forms of wood-fuel, e.g. pellets) and the recent rapid increase in oil prices have made this energy resource economically more attractive again, and resulted in a revival of interest in this source of bioenergy especially in countries and regions with abundant forests.

The use of the most traditional form of woody biomass, firewood is the main energy source still of detached houses especially in the rural areas, so much the more that it is the second largest source of space-heating energy in Finland (Tahvanainen et al., 2003). Besides this, according to many experts, there is abundant potential still in Finnish forests (forest residues, e.g. tree-top branches and stumps, early thinnings; e.g. Hakkila, 2006) and from forest industry to be utilised by the energy sector. Also, there is much environmental-political pressure to develop energy production capacities for utilising biomass, which in the past few years have become a major investment target of the large energy companies. However, there can be conditions which limit the *actual use* of this resource potential. Much of this resource is geographically dispersed, and there are certain technological and financial barriers in extracting forest residues. Beyond a 50 km radius, for instance, the transportation costs to the burners are too high for the smaller-scale enterprises at the forest-end of the chain while power plants are willing to pay yet little for woody biomass. Inefficient logistics further make this economic activity less profitable for the resource-end businesses. The local development potentials of the rising wood-fuel demand from the large energy firms are therefore not truly realised in the more remote areas, or regarding the smaller scale harvesting and transporting

businesses. There is a lot of concern with quality (low enough moisture content, homogeneity and cleanness) of the biomass delivered, and the reliability, punctuality of deliveries to the burners; the costs entailed in coming up to these crucial quality expectations are high. These all may result in a low profitability of biomass harvesting, processing and delivery in a situation when there are no targeted subsidies from the government.

It is also important to note in relation to the above that resources are not defined by nature, but by man, by society: it is the “human ability and need” which creates resource value (Rees, 1985: 11). “What is important is not some notional capacity but the potential for human beings to make the required investments, as well as the enormous social, attitudinal, organizational, and economic changes, which would be involved” (ibid: 25). Resources are culturally defined: they are “the product of social choice, technology and the workings of the economic system” (ibid: 31). And, “(t)he availability of renewable resources is dependent on the political, institutional and socio-economic systems which manage demand and supply and which determine the allocation of available flows over time and space” (225-226). Based on the literature and initial discussion with wood-energy entrepreneurs, this is very characteristic of the current situation of wood-energy business in Finland, and since many of these social and technological conditions are in a state of flux just now, interesting developments and dynamic changes in the related sectors are expected in the near future.

3 The (regional) environmental implications of (bio)energy production and consumption

The use of woody biomass for energy production can be an important factor 1) in the decrease of global and regional CO₂ emissions, 2) in the functioning of local forest industrial communities and 3) in achieving energy independence of these peripheries based on a clean, ‘homegrown’ energy instead of external and variable oil supplies. The shift from the centralised to this type of decentralised energy generation and distribution is encouraged for many socio-economic and environmental reasons.

Since the United Nations Framework Convention on Climate Change and the Kyoto protocol

(Strakhov, 2004), the European Union especially has taken the lead in promoting the use of renewable energy resources to combat global climate change by cutting CO₂ emissions drastically. EU member states, including Finland, are pushed towards measures to promote energy efficiency and the use of energy sources that are alternative to fossil fuels. The international and regional trade in CO₂ emission quotas is a system that allows for converting environmental-friendliness into cash, which can be in turn, invested into more innovation, as well as social welfare (however, the cumulative efficacy of the global trade in emission quotas against global warming is debatable).

The social (employment-related), environmental and economic aspects of wood-energy production and consumption are in fact, very much interrelated also on a local-regional level. For instance, district heating based on the woody biomass collected from surrounding forests and forest industrial plants are available already at lower prices to the population and institutions of some rural settlements in Eastern Finland. This, providing the production, transportation and transformation of these resources are also ecologically sound and sustainable, contributes directly to increasing living standards. Where the utilisation of wood energy is significant on a greater regional scale, CO₂ emission can stay well below the quotas; besides, some degree of economic independence from the global fluctuation in oil prices can be maintained in these areas, too. Nevertheless, as to ecological sustainability it needs to be emphasized again that a forests is a critical zone flow-type natural resource, as well as a contested resource, therefore when assessing their potentials for wood energy production, the forest management practices and the rate of regeneration, as well as *the multiple uses of the forests* need to be seriously considered (Vartiainen, 2006; FCNK, 2006; Niskanen, 2006).

4 Information and communication technologies for efficient co-operation

In the above, just a part of the total intricacy was highlighted concerning the situation and status of the wood energy sector in a rural, forest resource-based regional economy. There are global environmental interests and capital flows involved as much as regional resources, traditions, communities, and a great diversity of actors and factors from several sectors. There are many issues that deserve more consideration, research and experimentation, ranging from

practical problems such as the maximum distance of transportation of residues from forests and forest industry to the energy plant at which the economic and environmental advantages are still higher than the economic and environmental costs, or the ecological ‘footprints’ of trucks and chippers in the forests, to the more complex question of how geographically dispersed and small-scale businesses could increase their competitiveness in the wood-fuel and energy markets. Despite the fact that there is an abundant potential in Finnish forests, the question may still persist: will there be enough biomass to burn? If the wood energy business is not made attractive enough to forest owners, harvesters and transporters even the sustainably extractible biomass will remain in the forests. This problem is expected to increase as the demand for wood-fuel is rising due to the increasing investments of energy companies into their bioenergy capacities.

Some weaknesses were mentioned in the previous sections which prevent an adequate utilisation of potential resources as well as the manifestation of a possible endogenous local-regional development from wood-energy production and use. Many of these are connected to poor logistics.

Good logistics in this sector, too, should mean smooth and interactive information processes, data sharing routines, prompt control of tasks along a longer chain of actions involving a relatively high number and diversity of actors spread over great distances. Quality delivery is not generally assumed and expected from smaller enterprises, which result in their low competitiveness as compared to large scale forestry and energy companies. Also, to ensure the sustainability of forests while extracting material for energy purposes, extensive information and communication systems are needed which connect all activities from forests to burners in a certain region and ensure interactivity, and the sharing of prompt and accurate information between the actors working together. Furthermore, attractive, more versatile jobs, more state-of-the-art methods, and safer working conditions are required for the wood energy sector to thrive, and more opportunities for synergies from different occupational fields and perspectives.

Can ICTs help in these issues? The multidisciplinary nature of the R&D activities underlying

the development of the sector poses a challenge to public and private research: visibility and efficient, flexible modes of networking, joint learning, innovation transfer and co-operation are highly demanded. Keeping in mind that this research concentrates on the peripherally located businesses and rural societies, the use of the Internet as a medium for these strategic processes of communication and interaction should be investigated and enhanced in order to overcome peripherality. An interesting question is whether the on-line, ‘virtual’ relationships, linkages of the different organisations engaged in the wood-energy sector reproduce, strengthen or conversely, can work against the actually existing centre-periphery power relations.

5 Approach & methodology: on-line imprints of wood-energy networks

Based on the above mentioned technological-cultural specificities of the case study region, I assume that the Internet presence of and the inter-linkages among the main actors’ (organisations’) websites indicate their information and co-operation network. I suppose that this ‘virtual’ structure is on the one hand, the imprint of *existing relationships*, co-operations, directions of information flows, relationships of dependence and power, and on the other hand, is an indication of *intentions* towards and *limitations* to a further expansion of these activities and connections. I believe therefore, that it could be useful to detect and analyse the on-line manifestations of and the on-line tools implemented for, collaborations, sharing of information and the general promotion of the wood-E sector in Eastern Finland.

Consequently, I propose the analysis of both the ‘real’ and the Internet-based relations and processes, relying on several methods in both cases; and using the findings from the different exercises for triangulation. For the former type of enquiry, I have started gathering primary information via semi-structured personal interviews carried out with actors involved in relevant enterprises and other organisations, including software developers and specialised IT companies, and the wood-E enterprises themselves (e.g. chippers, heating centres). A questionnaire-based survey among wood-E businesses about their reliance on networking and ICT solutions can be also possible and useful. The collected data then will be for instance,

correlated with socio-economic indicators (age, income, size of enterprise, production statistics, location characteristics). In the on-line investigation, I wish to use some methods of *link analysis* that can be relevant to my case, to find answers to the following questions:

- Are there (and which are those) organisations which are especially central to the wood energy network in Eastern Finland, co-ordinating a major part of the activities? If yes, is this centrality shown in their web sites statistics, in for example, their so-called, 'inlinks' (hyperlinks to their sites from other organisations' sites)?

- If there is more than just one dominant organisation in the network, what is their division of labour and special function within the operation of the wood energy network and how are their functions present in their web sites' positions?

- Are there any bottlenecks within the on-line connectedness of these actors? What may be the reason for these, and how would the network be improved if these bottlenecks were eliminated? Are there any interesting examples of good practices that could be used elsewhere?

My plan is that in the end I map the relationships between the various actors, analyse their network in terms of the types of nodes (e.g. public, private, civil actors), different centralities, the types of links (e.g. the functions of connections), and if possible, in terms of the 'depth' (intensity) of interaction along those linkages, as well as the general growth pattern of the network with regards to the geographical-spatial distribution of actors and activities (e.g. linkages to organisations located in other, central regions; internationalisation). If this method is productive in the Finnish case study, it can be implemented to similar innovation networks originated in rural-peripheral areas, and can help draw more general conclusions as to how these networks can be improved and made more efficient (both on-line and off-line).

6 A summary of findings from initial investigations via interviews and a pilot on-line link-analysis

The method of following co-operation network lines via interviews has led me to gradually extend the researched area from the province of North Karelia to Eastern Finland and its immediate neighbourhood. The three interesting examples for ICT-supported activities are mapped in *Figure 3* below; these are the following:

1) WENET – Wood Energy Net – “Solutions for efficient and sustainable use of local wood energy resources” is coordinated by the Joensuu Regional Development Company, Josesk and financed also by The European Regional Development Fund (EU) and by the Regional Council of North Karelia. It is itself, a professional network of public and private actors based in, and expanding from, Joensuu (the centre of the province of North Karelia). Its aim is to help the regional wood energy actors and promote their practices also by organising forums, conferences, giving counselling, etc. It has also an ambition to advertise the region and its achievements in wood energy internationally and find partners all over Europe and beyond. Not surprisingly, a crucial medium for WENET is the Internet.

2) For much more concrete practical reasons were those independent networks of wood-E businesses formed within which the members are connected by their shared use of the MHG System’s *enterprise resource planning tool*. Many of them are based on regional Forest Owners Associations, non-profit organisations partly supported by public funding, too (the circle of users is growing fast esp. around the company headquarters, Mikkeli).

3) The service of the Mottinetti web-based wood-fuel auction and trading site is yet another and very different practice of using the Internet in this sector. It has a much narrower, more focussed task: matching the supply and demand sides of wood-fuel resources in a way that deliveries are more accurate and efficient, and the quality of the products are better guaranteed. It has been successfully operating and expanding for 10 years already.

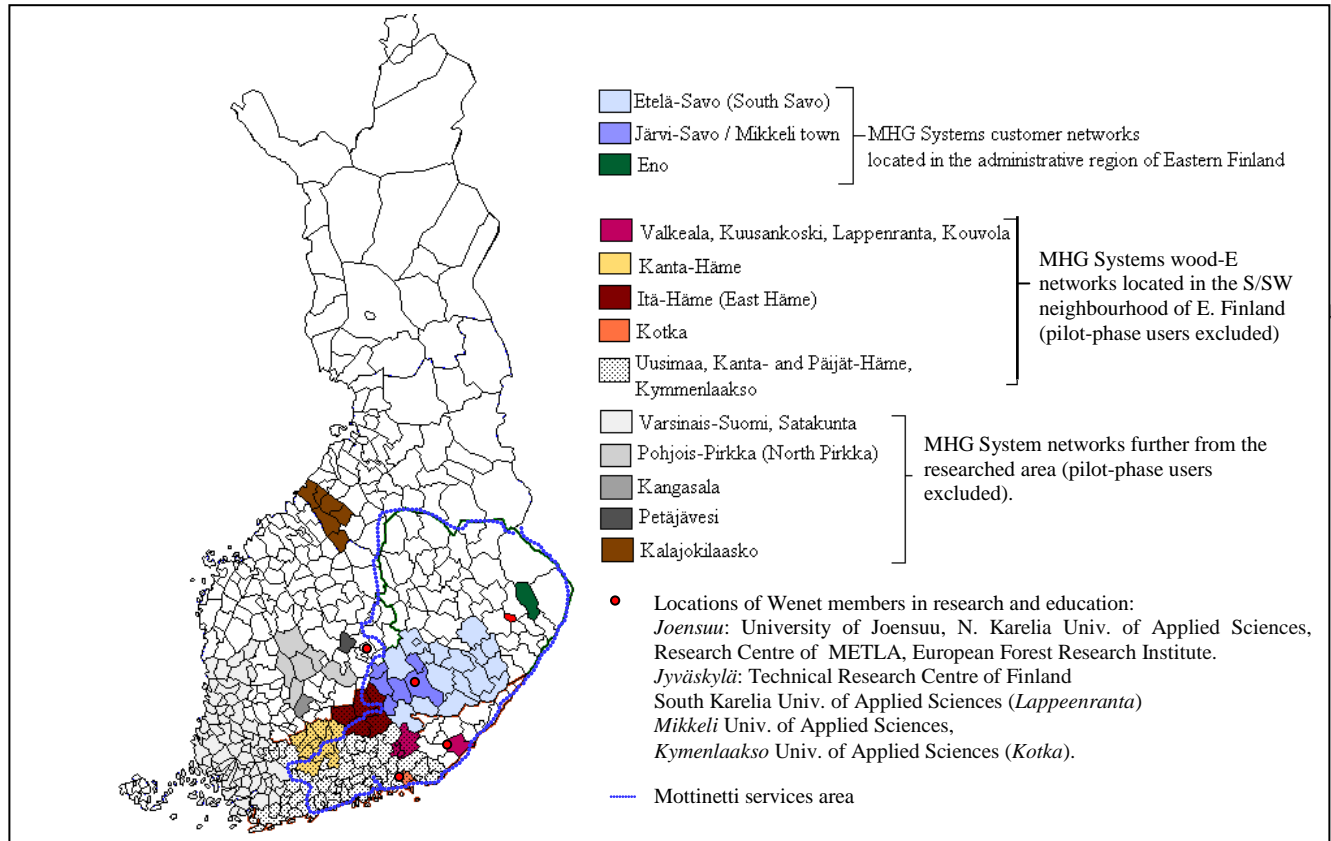


Figure 3. Examined WE networks and services

These three examples practically cover the geographical area of Eastern Finland (though wider than its administrative meaning as *lääni*). The actors involved in these are small and large companies alike. The interviews and the literature reviews confirmed that the issue – wood energy production and consumption – is a very multi-sectoral and multi-disciplinary one, and this is also reflected in the types of organisations involved: environmental, forestry related, energy sector related businesses and research, ICT providers, associations of SMEs in certain fields, local governments, etc. Further evidence for this was found already as a result of the following small pilot study.

Based on methodologically instructive literature (esp. Thelwall, 2004), I took a closer look at the web sites belonging to two of the three examined ‘projects’, WENET and MHG Systems Ltd. First, I used *Yahoo* → *Site Explorer* (link:www.wenet.fi/ and link:www.mhgsystems.com/) to find out about the size of these two web sites, and the

number of their inlinks (from pages outside the examined web sites to all pages of these two web sites). Since the number of inlinks were below 100 in both cases (56 and 95 respectively), I found the volume of this data small enough to be explored ‘manually’, by the individual web sites. This helped me to give a short definition of the contents and owners of the various inlinking web sites (see Table 1 about MHG inlinks.) This was also useful to filter out a few pages that were not relevant: in case of the inlinks to MHG, there were 4 such URL addresses.

Consequently, I used the software *LexiUrl* to create simple summaries of these two sets of inlinks, especially to order them according to the numbers of links to the target web sites, and to see which web sites the inlinking pages originate from (Table 1). Following this, I used the inlink web sites and the source web site as vertices in a simple network-digraph (created in the *Pajek* programme) where MHG or WENET is in the centre and the inlinks are connected to them with arrows.

I could discover that WENET and MHG have a mutual connection between their websites, however, not particularly strong (through 1+3 pages), and that there are two websites where from both WENET and MHG are referred to (they are colinked by these two web sites – see the table summarising inlinks to WENET). I also noticed that there are certain different types of web sites (organisations) which are represented among the inlinks: some are similar to the target site (organisation), and they may be even concrete co-operation partners; some others undertake complementary tasks (supporting services); some provide advertisement, publicity (e.g. e-magazines), or sponsorship etc. Understanding the differences in the nature of these ‘vertices’ helps to define the character of their relationships, and *vice versa*.

Some examples from the results (on-line linkages)

A) MHG System Ltd. (site size: 385 pages; valid inlinks: 56)

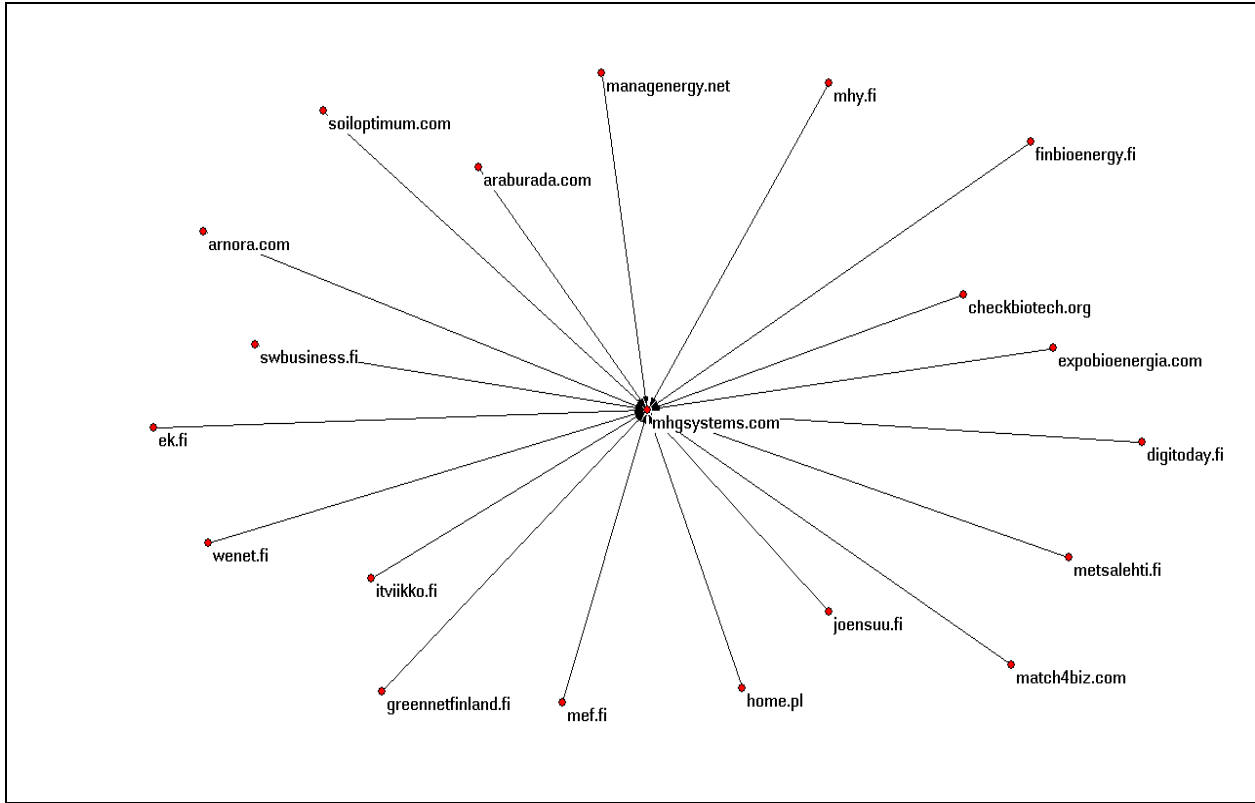


Figure 4. Inlinks of www.mhgsystems.com

Table 1. Sources of inlinks to all pages in the site www.mhgsystems.com website
(Created with Yahoo search and LexiURL)

All Pages (URLs)	Unique Pages	Domains	Site	Description of site and owner
17	17	1	swbusiness.fi	“SWBusiness.fi facilitates co-operation between the different players in the Finnish software business cluster by providing the latest news and information as well on upcoming events as on software companies and support services” ... maintained by The Centre of Expertise for Ubiquitous Computing, Helsinki, which is “based on networking the enterprises in the sector with universities and polytechnics in the region, public sector entities and business support services.” (Finland)
10	10	2	arnora.com	A Finnish ICT business expert organization. (Finland)
5	5	1	expobioenergia.com	“Expobioenergía’08, the third edition of the international fair specialising in bioenergy, is one of the most important events at international level...” (Spain and EU sponsor)
5	5	1	itviikko.fi	ITviikko: an IT weekly for Finnish business and IT professionals.
3	3	1	ek.fi	Confederation of Finnish Industries (non-profit, including several non-profit organizations, trade unions)
3	3	1	digitoday.fi	E-magazine - a fast digital news site, which publishes and analyzes events from the fields of IT, finance and media.

				(Finland)
2	2	1	mhy.fi	Forest Management Associations – some are clients=partners of MHG. (Finland)
2	2	1	metsalehti.fi	A Finnish e-paper on forestry by Metsäkustannus, “a multi-channel publishing house specialising in forestry.” (Finland)
1	1	1	match4biz.com	A business matchmaking web service. (Denmark)
1	1	1	home.pl	POMCERT – “to stimulate work on research, consulting and innovation programs within field of environmental protection in Pomeranian Region... set by the resolution of senates of three Universities: Medical University of Gdansk, Gdansk University of Technology and University of Gdansk.” (Poland)
1	1	1	checkbiotech.org	Provides information about rare diseases (Checkbiotech Orphan), life sciences (Checkbiotech BioValley), biofuels (Checkbiotech BioEnergy) and agricultural genetics (Checkbiotech GreenBio). Offering related companies branding, exposure, target audience. (Switzerland)
1	1	1	mef.fi	“Mobile Enterprise Factory is to promote the extensive utilization of mobile enterprise solutions in various industries. ...is coordinated by VTT Technical Research Centre of Finland. MEF runs as a project partly funded by Tekes, Finnish Funding Agency for Technology and Innovation, through 2007-2008. After this the activities of MEF will continue with a newly configured business model. (Finland)
1	1	1	wenet.fi	“WOOD ENERGY NET (Wenet) is a concept for the transfer of business models, technology and expertise from North Karelia to other parts of Europe and world wide. Inside the Wenet operates companies, research and training organizations from North Karelia and other parts of Finland as well as their partners abroad.” (Finland)
1	1	1	greennetfinland.fi	Green Net Finland is a network of environmental companies and public organizations. It aims at creating new business opportunities for its members through export of Finnish environmental know-how and technology. Green Net Finland is a network of environmental companies and public organizations. It aims at creating new business opportunities for its members through export of Finnish environmental know-how and technology. (MHG is a member) (Finland)
1	1	1	managenergy.net	“ManagEnergy is an initiative of the European Commission Directorate-General for Energy and Transport, which aims to support the work of actors working on energy efficiency and renewable energies at the local and regional level.”
1	1	1	cs.joensuu.fi	The Department of Computer Science and Statistics, University of Joensuu. (Finland)
1	1	1	finbioenergy.fi	FIBIO ry – The Bioenergy Association of Finland ry. “represents all actors of the bioenergy sector (Wood based fuels, Peat, Recovered energy fuels (REFs), Non-food crops, Biogas, Bioliquers). FINBIO promotes the sector’s joint interests in Finland and abroad, keeps its members up to date on developments of the sector internationally and it is a member and a national co-coordinator for AEBIOM (European Biomass Association). The membership of FINBIO: over 100 organisations and over 200 individual members.” (Finland)

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