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RENEWABLE ENERGY FUTURES IN FINLAND – BUSINESS CONCEPTS AND OPPORTUNITIES FOR GROWTH UP TO 2025

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Abstract

Decentralised energy production and markets for renewable energy (RE) technologies are expanding. To date, households, farms or small enterprises have received relatively little attention. Distributed systems can, however, be part of the energy sector change, and offer economic opportunities for small-scale energy producers and the producers, retailers and installers of energy devices. Policies play a major role in this process. RE growth is supported by both EU-level policies and national subsidy systems. The opportunities and challenges of this sector in Finland were assessed in this study. Data was gathered using a Delphi-based method. Experts from the RE technology chain answered a questionnaire in interviews or online. During the rounds, 50 driving forces were addressed in four broader themes, namely (1) RE technology solutions, (2) RE market functionality, (3) RE business concepts, and (4) energy policy and support to RE. The respondents gave their preferred and probable future view and an importance evaluation of each driving force using a five-step Likert scale. In addition, there was a set of questions about business opportunities. The material was analysed using a futures table method. Preliminary results indicate that attitudes, imperfect steering mechanisms and lack of reliable information and know-how were obstacles for distributed energy production. Service oriented business concepts together with adequate subsidies and administration were raised as potential means for creating growth in the distributed energy sector. As a conclusion, two questions arise for the future of distributed, small-scale renewable energy production in Finland: How will the RE business sector be able to form networks, co-operate and improve its business concepts? How will the government face the challenge of legislation that slows down the expansion of new business concepts, grid-connections and installations? Depending on the answers, the RE future in Finland can follow very different paths.

Keywords: Business concepts, Delphi method, Future paths, Renewable energy

Introduction

Decentralised energy production and markets for renewable energy (RE) technologies are expanding. This is due to the greener policy goals within European Union and globally resulting from sustainability concerns. All EU countries have agreed in the energy and climate package to increase energy efficiency by 20%, utilisation of renewable energy sources by 20% and to reduce CO2 emissions by 20% by the year 2020 (EU Commission 2014). Even more ambitiously, a national target to reduce GHG emissions by 80% below 1990 levels by 2050 was set in a Finnish Government's foresight report (Prime Minister's ... 2009). In the face of changing operational environment, whether driven by internal or external forces, the future of the energy sector in many countries is characterised by uncertainty. This paper attempts to shed light on this discussion by presenting current and future state and development of renewable energy in Finland in order to support energy policy making in Finland.

Policies play a major role, as growth is supported by, e.g. EU policies for renewable energy and subsidy systems introduced in all EU member states. The allocation of support systems varies. For example, in Finland the feed-in-tariffs are allocated to large-scaled plants whereas in Germany small-scaled energy production is more extensively supported (Fulton & Capalino 2012, Koistinen et al. 2014). The German *Energiewende* is one example of a strong turnaround in long range energy policy (BMU 2012a). As a result, consumer electricity prices have risen, but at the same time, the capacities of different renewable energy sources have increased considerably (Trendresearch 2011). This has meant new business opportunities and a need for new networks and concepts to emerge in local level (Wasserman et al. 2012).

Before business opportunities turn business and concepts emerge as full blown business models, testing of the future options should be studied. As said, the role of policy in vital, but there is also a need to scrutinise the whole picture in renewable energy development including e.g. technological solutions, market functionality, value creation chain and emerging business concepts. In creating an overall picture Future-oriented Technology Analysis can contribute greatly. According to Cagnin et al. (2013) Future-oriented Technology Analysis (FTA) has a potentially useful role to play in enabling a better understanding of complex situations and in defining effective policy responses, including 1) improving the quality and robustness of anticipatory intelligence and preparedness for disruptive events through the use of systematic approaches and the development of shared insights and perceptions., 2) creating spaces for dialogue between key players from different domains, with diverging views and experiences, 3) vision-building and consensus-building for considering and inducing "guided" processes of transformation and 4) shaping and defining dialogues on transformations and policy discussions on tackling these major changes, as well as research and innovation agendas to support these dialogues and policy discussions.

Various tools and techniques have been developed that seek to better anticipate and shape future technological developments. Some of these approaches, particularly early on, tended to be techno-determinist in their outlook, but more recently, a greater acknowledgement of the co-evolution of technology and society has led to the adoption of necessarily more complex perspectives. Some approaches have been purely quantitative, others purely qualitative, whilst a mix is often preferred. Some have involved only 'experts', whilst others have sought to initiate a societal dialogue (Cagnin and Keenan 2008). As the nature of industrial production is changing with greater emphasis on networks, strategic alliances, supply chains and national systems of innovation the nature of knowledge production is simultaneously evolving (Martin and Johnston, 1999).

These starting points in mind we conducted a Delphi study among the small-scale, distributed RE technology chain during 2012-2014. In this paper one FTA method, the Delphi technique was used in anticipating the business concepts and opportunities, public policy support as well as the obstacles in the growth of renewable energy (RE) production in Finland. This is done through a process in which preferred and probable future views of an expert panel were asked.

Methodological approach

Delphi as a research method has been widely used in futures studies and FTA approach. The users of the Delphi technique aim to predict and explore alternative future images, possibilities, their probabilities of occurrence, and their desirability by tapping the expertise of respondents (Linstone and Turoff 1975). The material of this study consists of a Delphi-based process that was conducted in Finland in August 2013 – March 2014. The results were discussed and elaborated in a workshop, and the viewpoints raised there have been used as secondary material. The full results of the second Delphi round are presented as scenarios elsewhere (Varho et. al. 2014).

The experts were selected to represent the value chain of renewable, distributed energy production in Finland. The purpose was to cover the relevant viewpoints to be found within the field, and this was thought to be achieved best with a wide range of experts. Some panellists could be considered stakeholders rather than experts in a strict academic sense (see also Varho and Huutoniemi 2014). The first characterisation of respondents was done by the research team in order to find appropriate panellists. In addition, the respondents were asked to estimate their own expertise to get a transparent view on the expertise in hand. The expertise of the panel that completed the first round are itemised in Figures 1 and 2.

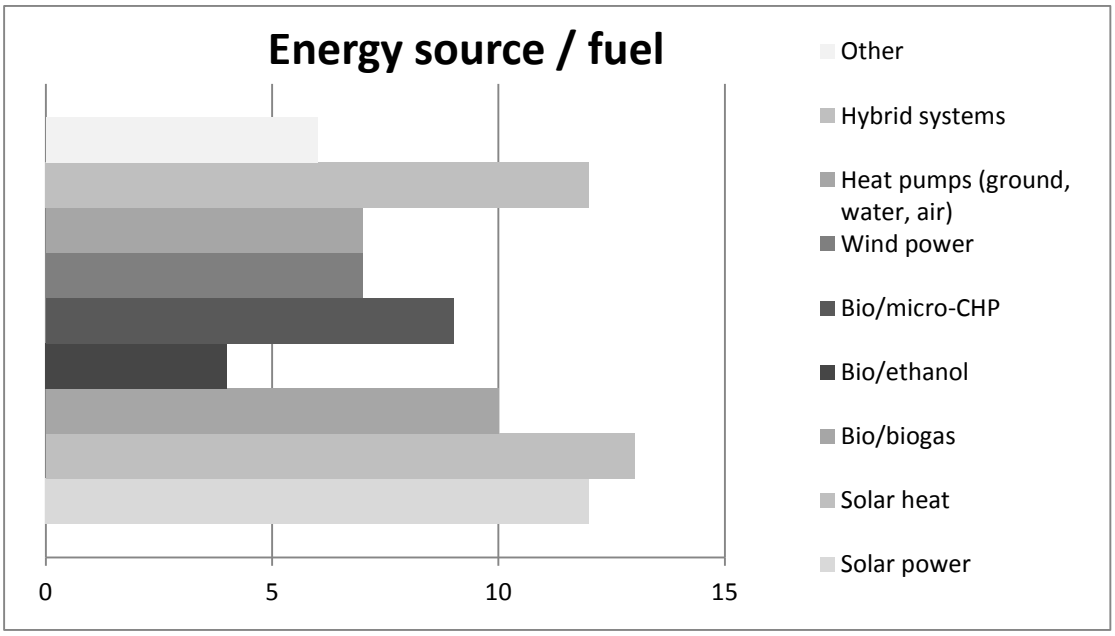

Figure 1. The energy source/fuel the panellists were most familiar with, based on their own estimations.

Solar power and heat as well as hybrid systems are somewhat more represented in the panel than other individual technologies. However, by combining together all bio-based technologies, also bioenergy is strongly represented. Eight panellists work in large organisations of over 250

employees. Four panellists work in middle-sized organisations and six in small organisations of fewer than 50 employees.

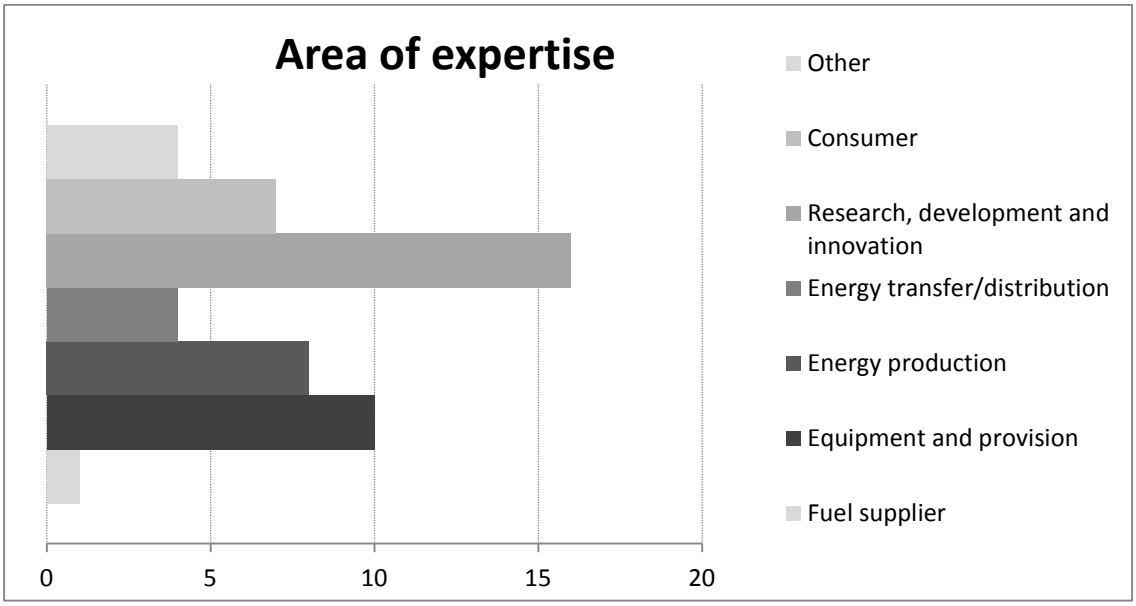

Figure 2. The role in the RE value chain the panellists were most familiar with, based on their own estimations.

The first round of the Delphi study data was gathered mainly through semi-structured interviews. The structure of the first round questionnaire allowed experts to express new questions or statements of their own. During the first round, 17 persons answered a questionnaire in face-to-face interviews. Further 9 experts responded to a similar questionnaire online.

In the first round, altogether 50 driving forces were addressed concerning the renewable, distributed energy production in Finland. These were asked under four themes, namely (1) RE technology solutions, (2) RE market functionality, (3) RE business concepts, and (4) energy policy and support to RE. The respondents gave their preferred and probable future view and an importance evaluation of each individual driving force using a five-step Likert scale. The answers were asked for on the Likert-scale of –2 to 2 (–2 refers to substantial decrease from present level, 0 refers to no changes to present level and 2 refers to substantial increase from present level). There was also a set of questions about business opportunities, and some open ended questions. During the first round, the panellists were asked to present important obstacles in Finland for the growth of distributed RE capacity.

As part of the second round the panellists were asked to vote about the obstacle list gathered from the first round answers. In this way they pinpointed the most important obstacles for the growth of RE capacity in Finland by 2025. These results were further elaborated in a workshop which was organised for the participants of the research consortium community. The participants were mainly researchers, although a few business representatives also participated. The 14 participants were divided into groups of three, and each group completed two tasks. First, they were asked to consider ten obstacles that had been identified as important in terms of hindering the growth of distributed renewable energy production capacity. The groups were asked to consider how much effort should be spent in order to solve each obstacle in the Finnish society in the next five years. The idea was that although a problem is considered important, it is not

necessarily solvable at least in the short term or by national-level actors. Therefore action might more realistically or profitably be directed at another problem.

The second task was to pick one of the ten obstacles and envision a state in 2025 where this obstacle has been removed. The groups were asked to be creative and to imagine what kind of changes had taken place in e.g., policy, societal sector, markets, and consumer behaviour. They were also asked to name who or what had effected this change.

Results, discussion and implications

As said, in the first questionnaire section the panelists evaluated 1) preferred, 2) probable future view and 3) importance of a topic out of the asked 50 topics. The average values received by these five topics are presented in Figure 3. According to the results the respondents emphasised concerns about how smooth it is to get the small-scale RE surplus production to grid from households, farms and small enterprises. This was strongly preferred to increase, but the panel considered it also quite probable. It seems that there are still challenges in the market functionality and the expert panel wished for small-scale producer's surplus electricity net metering to materialize. The number of hybrid energy systems in households, farms and small enterprises in small-scale production of heat and power was also seen strongly increasing (both preferred and probable). The panelists also called for more mid-sized equipment or component manufacturers in the market. The fourth important topic was considered to be the growing public acceptance to distributed small-scale renewable energy production. The clarity and ease of the construction permit process for implementation of small-scale RE production (including the length of the process) was preferred, but the confidence to be successful and smooth in this process was not seen as probable.

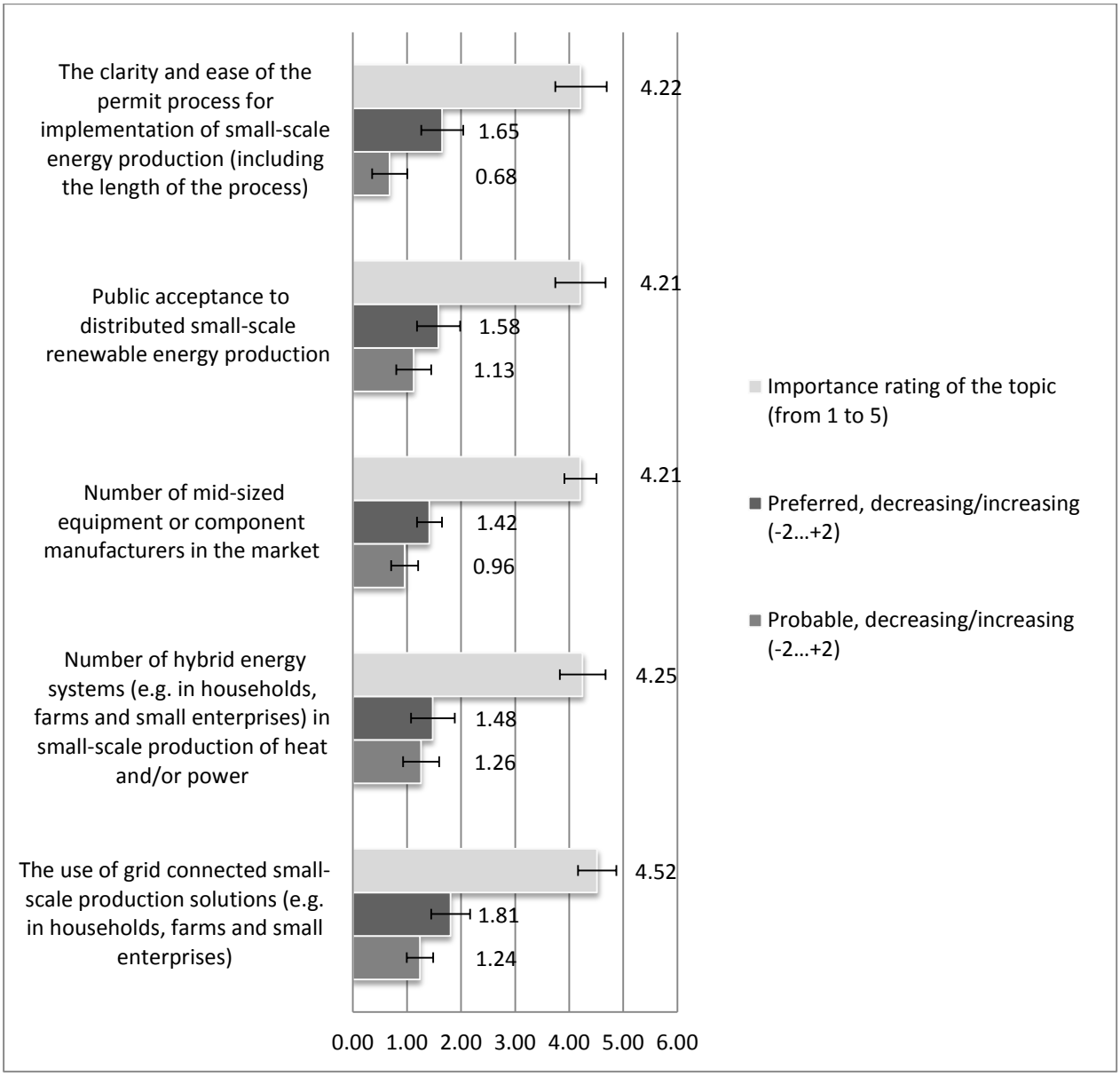

Figure 3. The importance, preferred and probable future views (Mean) of top-5 topics (note that the decrease/increase are given on a scale different from the importance)

The emergence of new business concepts

According to the results (Table 1) the most preferred business concepts were the turnkey concepts, independent web-services that offer alternatives for selecting an energy system, ”production-site rent” –packages and virtual power plants in energy production. The probable future view is quite similar, but raises in addition services for small-scaled energy producers in where the technology supplier manages the cooperation and contracts with grid manager as probable too.

Table 1. Envisioned development of business concepts, arranged by perceived importance.

Business concept	Preferred future view decrease/increase (-2…+2)		Probable future view decrease/increase (-2…+2)		The relative importance (1…5)	
	Mean	SD	Mean	SD	Mean	SD
Number of business networks that offer turnkey concepts for small-scale production	1.36	0.64	0.83	0.56	3.72	0.98
Independent web-services that offer alternatives for selecting an energy system solution to one's home.	1.27	0.92	0.85	0.67	3.69	1.09
Personal consultation services for choosing an energy system for one's home	1.23	0.76	0.77	0.59	3.56	1.12
Number of "production-site rent" –packages, where a company installs and operates a renewable energy system on site it rents (e.g. roof or land)	1.38	0.75	0.76	0.60	3.56	1.26
Financing options offered by energy companies to distributed energy system investments (e.g. to households, farms and small enterprises)	1.17	0.64	0.54	0.72	3.54	1.32
Collective investments in RE small-scale systems procurement (i.a. crowd funding)	1.19	0.90	0.69	0.68	3.52	1.12
Virtual power plants in energy production (integrating growing number of distributed and renewable energy resources together as one virtual entity into the grid and into the markets)	1.28	0.79	0.58	0.64	3.52	1.16
Service for small-scaled energy producers in where the technology supplier manages the cooperation and contracts with grid manager	1.15	0.73	0.85	0.67	3.31	1.26
The number of cooperatives in local small-scaled RE production	1.08	0.80	0.54	0.71	3.28	1.14
The rented small-scaled energy system machinery from the energy company	0.88	0.77	0.65	0.69	3.00	1.36

In the second Delphi round, the panelists were asked about the business concepts that would become common in the market. In this evaluation the small-scaled RE production sites (in farms, households etc.) whose production is marketed and sold by energy company, were seen as most growing concept in the evaluated list. Turnkey concepts, joint investments and "production-

site rent" –packages follows quite equally. It is somewhat surprising that the cooperatives in small-scale RE production were not seen as a probable way to organize ownership and production of RE.

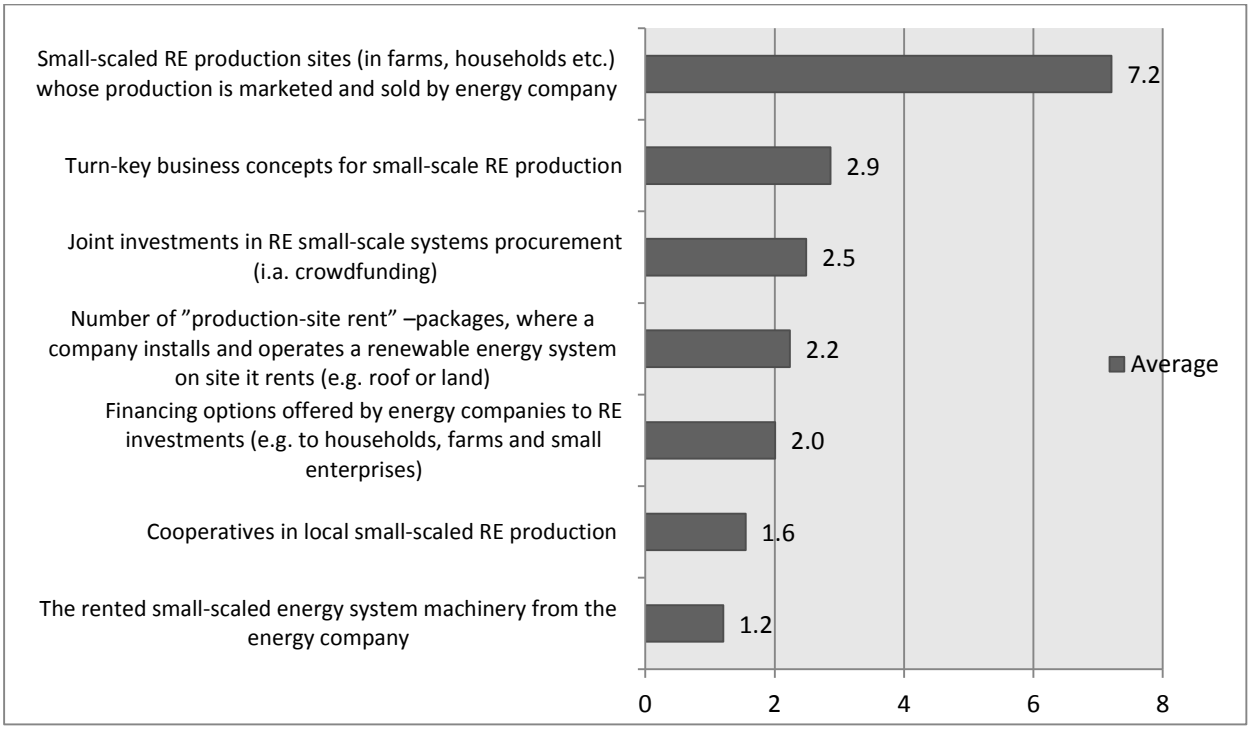

Figure 4. Business concepts emergence between 2013-2025 (current state 2013 is given as index=1).

The capacity growth in RE proposed by the panel

The panelists were also asked about the capacity growth of different RE sources in small-scale production. Because comparable statistics were not available, the current state (year 2013) was given as index=1. The panel gave a strong support for solar based capacity growth supported by the hybrid systems. It seems rather consistent result in the light of the business concepts emergence too. It is likely that the small-scale production are gathered and distributed by a larger energy company. It is notable that the air or ground-source heat pumps did not get strong growth rate from the panel, but this may come from the fact that these technologies are already in strong use in energy production.

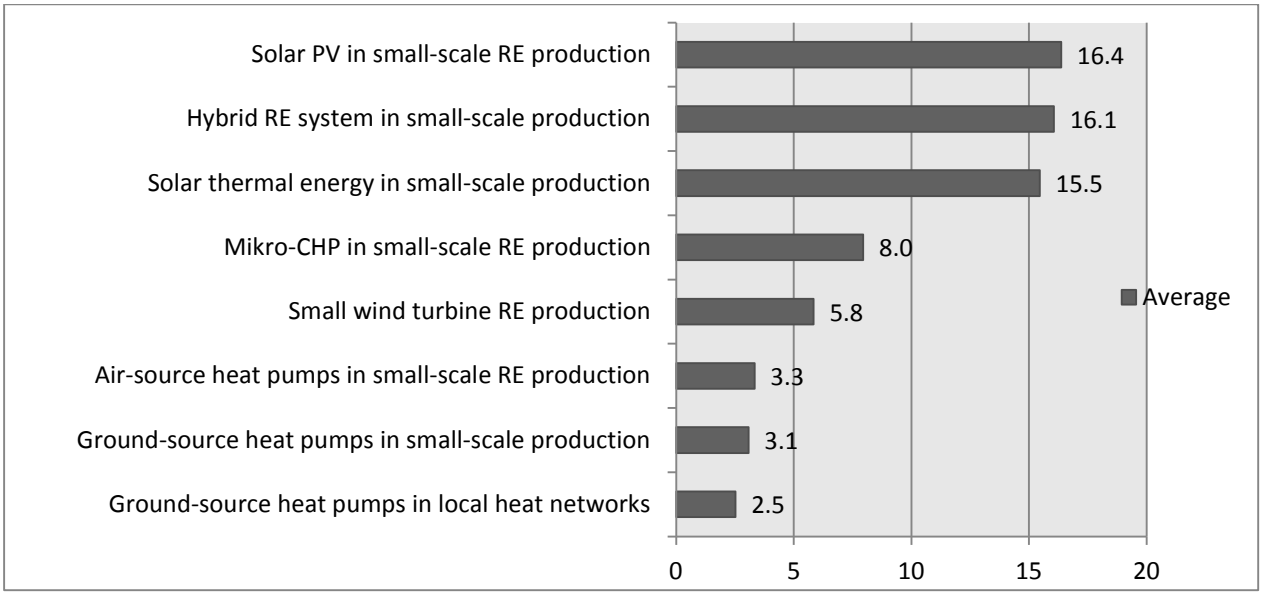

Figure 5. Capacity growth between 2013-2025 (current state 2013 is given as index=1).

The business opportunities within the RE value chain

The panelists were asked about the business opportunities within the RE value chain in solar power, solar heat and micro/small-CHP (Table 2). In solar power business the opportunities come from the supply of turnkey services, from installation phase and from planning and purchasing phase. The situation is quite same in the solar heat, but in addition the manufacturing phase was considered to contain more opportunities than in solar power. The micro/small-CHP business opportunities are equivalent to the solar power results.

Table 2. Envisioned development of business opportunities, arranged by decreasing perceived importance.

Business opportunities	**Solar power decrease/increase (-2…+2)**		**Solar heat decrease/increase (-2…+2)**		**Micro/small-CHP decrease/increase (-2…+2)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Manufacturing phase of the components and apparatus	0.88	0.97	1.25	0.61	1.13	0.85
Planning and purchasing phase (e.g. choosing suitable energy system, tailoring the purchasing process, developing the ease of procurement, contracts etc.)	1.33	0.64	1.26	0.69	1.33	0.73
Installation phase of the RE system	1.36	0.64	1.29	0.62	1.26	0.75
Using and maintenance phase (e.g. advisory services, consultancy, maintenance, aggregative services)	1.00	0.71	1.04	0.69	1.17	0.78

Renewal phase of the energy system (e.g. renewal, updating, replaceing investment, recycling)	0.75	0.79	0.74	0.69	0.77	0.75
Turnkey services (all the phases)	1.44	0.58	1.42	0.65	1.35	0.71
Grid connection services for small-scalew production	1.08	0.65	0.74	0.75	1.00	0.60

The obstacles of the growth in RE solutions

The panellists considered the underdevelopment of business concepts such as turnkey solutions the greatest obstacle for small-scale RE capacity growth (receiving 13 “votes”). Also the difficulty to find trustworthy information on RE systems (9), the insufficient availability of professional sales and installation services (8), the difficulty or lacking profitability of selling small amounts of electricity (8), and the price of production systems (7) were among the top five barriers for capacity growth.

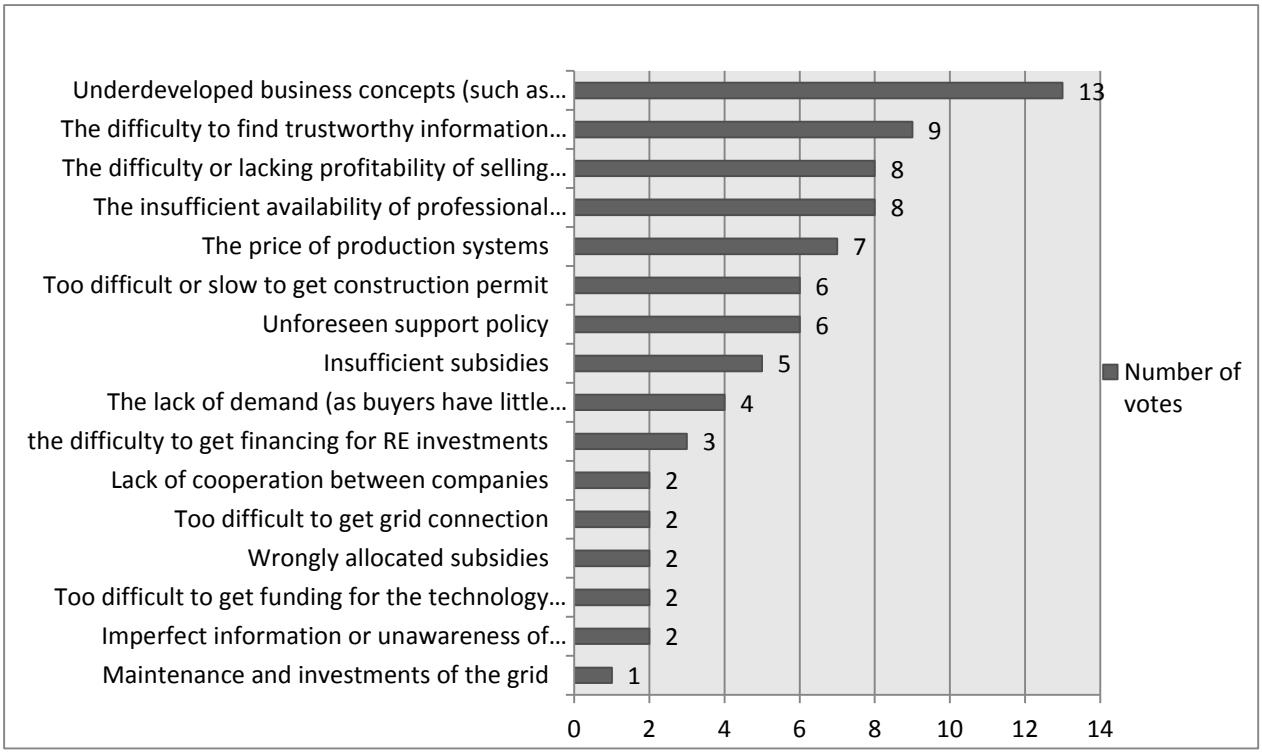

Figure 6. Obstacles for the growth in distributed RE. The Delphi panelists each had up to five “votes”.

The workshop evaluation of the Delphi results

The workshop was organised to further analyse the results of the Delphi process. The workshop participants were asked to rate how vigorously the obstacles should be addressed in the next five years. Although there was variation between the answers, the participants advocated focusing on the unpredictability of policy, difficulty or slowness of getting permits, underdevelopment of business concepts, difficulty to find trustworthy information, and the insufficient availability of professional sales and installation services. On the other hand, they

considered the price, insufficient subsidies and lack of demand to be issues that should not receive as much attention within five years. This indicates that the participants did not consider the cost to be the most significant barrier for consumers. Instead, it is the practical difficulties that count. Consumers may be interested in new solutions and even willing to pay for them, but unable to get them easily and conveniently into their houses.

The solutions envisioned by the workshop participants also reflected the importance of streamlining and firming policy and legislation as well as of businesses to be bold, innovative and co-operating with one another. For example, companies selling and building individual homes could focus on hybrid systems combining wood heating and solar electricity. Currently the houses, the heating, and the electricity are often designed and installed by separate companies.

Conclusions

In this paper the business concepts and opportunities of RE were scrutinised through Delphi-based process. Two of the phases were conducted by interviews and online survey and in the third phase feedback was gained from a workshop of R&D experts.

As a conclusion, the expert panel wished that the RE solutions, the markets for energy production, the business concepts and the policy support would develop in favour of small-scaled RE until 2025. The preferred future view demonstrated stronger growth than the probable future. However, both views (preferred and probable) included strong increase rather than decrease or no change. In the preferred future view the deviation in answers were also greater. The business opportunities were seen increasing mostly in planning and purchasing phase, in installation phase and in turnkey concepts for small-scale production.

According to the Delphi process there are evident benefits and strengths that should be highlighted in national energy policy discussion. The distributed, small-scale renewable energy production means increase in energy self sufficiency, decentralizing risks, security of supply, work opportunities, and export opportunities. The strengths to answer to the increase of RE growth are technology optimism, high educational level, enterprise friendly culture, good condition of grids and the infrastructure overall and the well organized energy system In Finland. There was faith among the panelists that competitiveness of RE will increase due to the tightening climate policy and the rise of energy prices. In the current situation, as a big share of renewable energy comes from forest industry, the room for extra small-scale RE energy was considered feasible, especially in sparsely populated area.

There are several direct measures and actions that can be taken when promoting renewable energy growth. The current policy support concentrates on large scale energy production in few RE sources In Finland (wood fuel, wind power, bio gas) and the panel wished for a transition to support also small-scale production both with subsidies and governance. Also, more can be done in service development as the technological solutions are available. This also calls for more networking and joint development between technology and service providers. There is also a need for independent information services that can provide valid information for choices e.g. for the most energy-efficient, suitable solution in the area. In addition, professionalism was called for. Currently the RE businesses were seen as too small and amateurish to be viable businesses capable to grow. The states and municipalities can set good examples in demonstrating RE energy solutions.

As a conclusion, two questions arise for the future of distributed, small-scale renewable energy production in Finland: How will the RE business sector be able to form networks, co-operate and

improve its business concepts? How will the government face the challenge of legislation that slows down the expansion of new business concepts, grid-connections and installations? Overall it seems that technological solutions are already available, but there is a need to speed up transformation of the energy production system through social and economic innovations. Even if the economic situation is not satisfactory in Europe, nor are the resources for public finance extensive, public investments and strong policy support are very important for the growth of distributed, small-scale RE capacity. This also includes the transparent legislation and governance of the RE investment possibilities.

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