

19th International Scientific Conference; Economics and Management 2014, ICEM 2014, 23-25
April 2014, Riga, Latvia

Designing routes of development of renewable energy technologies

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Abstract

The article first presents the concept of the routing technology development and its components. Next, with regard to the RES technology, routing design phases were synthetically characterized and illustrated. Further, a general diagram of the renewable energy technologies route development was presented.

The presented proposal of the route of the RES energy technologies should allow for coordination of the development of the technical potential of renewable energy sources, and development of paths of implementation of the desired vision for technology development of renewable energy sources with a horizon for a dozen years or so.

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Peer-review under responsibility of the Kaunas University of Technology.

Keywords: Technology development; technology roadmapping; renewable energy sources.

1. Introduction

Currently, one of the most important challenges facing the Polish, but also global energy economy, is its adaptation to the requirements of the global low-carbon economy, which is characterized by high energy efficiency, rational management of energy demand, and, above all, a much higher use of renewable energy sources. The issue of renewable energy is a major, not only political, economic but also scientific challenge. There are many, both, technical and organizational issues related to this topic. Technical aspect, and in particular research on new technologies of renewable energy sources, are the subject of many research works. An organizational aspect, and, in particular, issues related to the management of renewable energy technologies are discussed occasionally (Czaplicka-Kolarz, 2007; Halicka, 2013). It should be emphasized that from the point of view of a country, a region, a company or an organization, creation and maintenance of relationships between technological resources of

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renewable energy sources and the adopted political or strategic objectives are essential. This requires effective communication, dialogue and understanding, and effective management of the available knowledge. It is necessary to adopt an appropriate method of management of technology, as is the case with issues of quality, environment, safety, etc. Technology management is aimed at the effective identification, selection, acquisition (purchase / transfer), exploration, and protection of technologies in order to achieve and maintain, or increase high market position, based on the objectives of the organization (Phaal, Farrukh, & Probert, 2001; Phaal, Farrukh, & Probert, 2003).

Due to the complexity and global pace of change, an effective management of technology is a difficult process that requires taking into account the specific systems and processes, adapting to market needs and industry, both in the present, as well as in a long term perspective. According to Klincewicz (2010), important problems of the technology management include, inter alia, "(1) understanding the emerging technologies and their relevance to the current activity of the company, (2) identification of opportunities and risks associated with the development of technology and the choice of technologies of strategic importance, (3) choice of technology of strategic and tactical significance" (Klincewicz, 2010). Helpful in eliminating the abovementioned problems, particularly in the long term perspective, is the usage of the methods of strategic planning. One such tools is the method of technology roadmapping.

The main objective of this paper is to present the possibility of using the method of technology roadmapping to build the route of development of RES technologies. The article is of review-theoretical character and is the beginning of further work in this area. This paper presents the basic principles for the design of routes of development of renewable energy technologies. Also, a general, preliminary schematic of the route of RE technologies development has been proposed. The presented scheme has been developed based on literature studies, as well as based on the experience and knowledge of the author. In further research, conducted by the author, it will be verified.

2. Method

The technology roadmapping method was developed at Motorola in the '70s of the twentieth century as a tool for strategic planning and investment decision support, especially in the scope of the optimal placing of new products and technologies on the market, in the context of the prospective directions of research (Bernal, Dornberger, Torres, & Byrnes, 2008; Richey & Grinnell, 2004). The term technology roadmapping appears in the Polish literature on the subject in many contexts. The UNIDO guide explains the concept to be a roadmap for technology or technology development plans. Another of the common terms is creation of routing of the technology development (Gudanowska, 2012). According to the author of the article, this last term is of logical and simple nature, and presents the expected effect of the method. The authors of the article will use the routing of the technology development term to determine the effects of the method implementation. It should be noted that the time factor is characteristic to this method. It is apparent in the literature that the manners of visualization of the technology roadmapping method present quite diverse approaches; however, eventually they lead to arranging the directions of the scientific research and technologies in their broader context, taking into account the time line – in a dynamic approach.

The method of routing the technology development enables to reach consensus on the expected, preferred development of the researched technological area through the integration of multi-dimensional perspectives of the various stakeholders involved in the process. The route of technology development – the result of roadmapping – is a graphical tool showing correlated in a given period of time actions to be taken in order to develop innovative process or product solutions (Gudanowska & Kononiuk, 2013).

The essence of the routing of the technology development is to visualize the relationship between the realm of science, technology and business practices, as well as to identify the new opportunities in the field of development of new technologies.

The advantages of technological roadmapping method include (Kleiber, 2011):

- effective identification of key energy technologies that have the highest potential for growth in the future;
- identification of alternative energy technologies;
- identification of the technological niches in the study area;

- stimulation of discussion and facilitation of communication between the various communities of stakeholders;
- creation of multi-faceted, long-term plans for the development of technology;
- identification of the future market needs;
- identification of the industrial technology priority areas;
- stimulation of the cooperation networks generation.

The result of the technology roadmapping – the route of technology development – can also be an information tool that can be used in the promotion and marketing of the analyzed energy technologies.

Although the problems associated with the technology roadmapping method are described in the reference literature (Amer & Daim, 2010; Daim & Oliver, 2008; Richey & Grinnell, 2004), due to the specificity of Polish the energy sector, the discussion contained therein cannot be easily transferred into the Polish reality. After the performance of the survey of studies on the technology roadmapping method conducted in Poland it was noted that only in the project Scenarios of technological development of the fuel and energy complex for ensuring energy security of the country the routes of technology development were prepared. However, these routes have been developed for the entire area of renewable sources.

The method of routing of the technology development is a tool enabling identification of rational opportunities for the development of sectors, including the energy sector. The route of the technology development allows for the presentation of the development of the energy sector, or groups of the energy technology, essential in terms of market, product, and technology, taking into account technological resources.

3. Results

Due to the formulated by the European Commission action plans for energy, which assume security, competitiveness, efficiency, use of renewable resources, and low-carbon energy sector, it is important to design routes of renewable energy technologies that meet market and legislation requirements.

Taking the above considerations into account and considering the time horizon of strategic documents on the development of the Polish energy sector, it seems appropriate to develop the routing of the RES technology development in Poland in two time horizons: in the perspective to the year 2030 and 2050.

Creation of the routes of the RES technology development should take place in three phases: initial, fundamental, and an implementation (Cuhls & Johnston, 2008). In the initial stage, in addition to the designation of the objective of the RES technology route construction, it is also necessary to determine the work schedule. The fundamental phase involving the preparation of the renewable energy technology route development, in the perspective of the year 2030 and 2050, should include the following elements (Gudanowska & Kononiuk, 2013):

- identification of the main market forces,
- determination of the market demand for renewable energy technologies,
- identification of potential directions of development of renewable energy technology,
- establishment of milestones of development of the renewable energy technology.

Whereas, an implementation phase should be based on the analysis and validation of the designed route, and the preparation of the plan of its implementation and update.

According to the author, the design of routing of the RES technology development should be based on the concept of Phaal (2001), taking the planning of the technology development model into consideration, and consisting of (Richey & Grinnell, 2004; Cetindamar, Phaal, & Propert, 2009; Phaal et al., 2001; Phaal et al., 2003):

- needs of the industrial, scientific and research sector, the country, and the organization;
- products, services and projects that will meet the identified needs;
- directions of research allowing for the development or production of new products and services;
- potential and resources that will allow for the implementation of the desired vision of development.

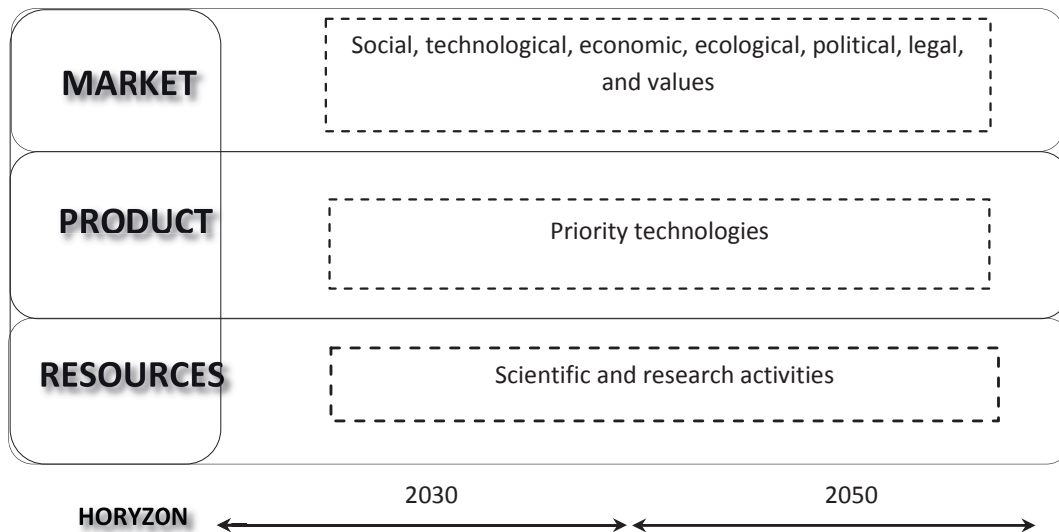


Figure 1. General scheme of the RES technologies route development

The author proposes the route of development of the RES technologies to consist of three layers: the market, the product, and the resources (Cuhls & Johnston, 2008). The layer the product should include the priority technologies. The catalogue of the future, key technologies should be developed by an interdisciplinary team of experts, representatives of the scientific and economic communities, and non-governmental organizations. Experts should include the representatives of the scientific, economic, and governmental organizations, related to renewable energy sources and development policy and the socio-economic development. The market layer should take into account the social, technological, economic, ecological, political, legislative determinants and values that determine the development of the product layers. On the other hand, the resources layer refers to the qualifications and competencies necessary for the manufacture, use or development of renewable energy technologies. The scheme of route of development of the RES technologies is presented in Figure 1.

4. Conclusions

The above observations allow us to conclude that due to the adopted strategic objectives, developments in the area of competitiveness and innovativeness of, both, Polish and EU economy, the undertaken in this article problem of designing routes of development of renewable energy technologies, particularly within the Polish experience, is a new and important problem.

The project of the RES route, which was developed within the framework of this article, will enable the coordination of development of the technical potential of renewable energy sources, and development of paths of implementation of the desired vision for technology development of renewable energy sources in Poland in two time perspectives: 2030 and by 2050. Production of knowledge necessary in the process of shaping of a proper energy policy of the country will also be possible. Thusly obtained knowledge may provide a basis for managing the energy security of the state.

The aim of this study was to present the basic assumptions of the design of routes of RE technologies development, and to present a general scheme of the route of development of renewable energy technologies. The next stage of research will be to develop a route for a specific, single selected renewable energy technology according to an authorial research process. This process has been developed by the author, based on the experience of management in the energy market.

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