

## RENEWABLE ENERGY SOURCES VS INNOVATIVENESS OF THE ECONOMY ON THE BASIS OF THE EUROPEAN UNION'S COUNTRIES

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### **Abstract:**

The energy independency issue is an important question for The European Union (EU), the EU should ordain aims and targets for membership countries to achieve some levels of implementation of renewable sources within a scheduled time. The EU is also spending a lot of expenses for research and development (R&D). Simultaneously implementation of renewable conducting to increase the level of innovation. This article describes what kind of innovations are produced by beefing up renewables and critical relations between general expenditure for renewable and innovation levels.

*Keywords: Renewables, energy, innovation, EU*

## 1. INTRODUCTION

Improving renewable sources exploiting issue is significant case for European Union (EU) to provide energetic safety, efficient using limited area, which are intended to food producing, preserve and protect an environment and making up to climate changing hold back.

In due course EU is also require increasing innovations level. In literature is often suggested that introducing renewable energy grid also can fluent on level of innovations owing to rise of knowledge populations and a new area for creating invention (strength in number). Also providing renewable energy gird there will came an opportunity to increase an differential connections and make easy for ordinary users to develop and make up own connection. And also in rate of decrease numbers of household connecting to the net, cost of unit connection will stripped down.

Introducing renewable sources implicate an expenditure which need to be bear for gears and facilities, research and public administration in this case.

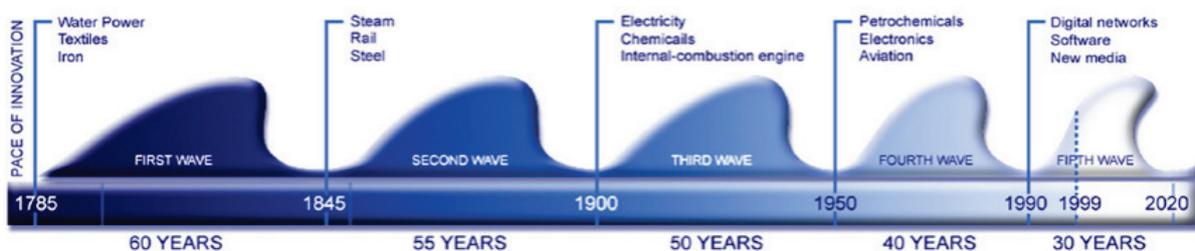
## 2. INNOVATIONS

Innovation is generally using to characterise differential products develop on the market notion, but in literature isn't strictly criterions defined in particular way sense of it.

World etymology comes up from Latinate innovation, it's mean renewal. This term connotation is everything what is new, for example technical or technological, organizational changing, in management, production, in the media and communications<sup>1</sup>.

For the start I want to perform different definitions of innovations. First, who attend to innovation issue on economy area was Joseph Schumpeter, attribute innovations to exogenous factor economic growth. He thought, that available resource innovations became possible for make wealth on new ways<sup>2</sup>. Also he compare rate of economic growth to waves, impacted by basic change productions and services inventions.

**Figure 1:** Schumpeter waves of impact of the technological change on the economy



Source: [https://www.researchgate.net/figure/251631233\\_fig2\\_Fig-2-Schumpeter-waves-of-impact-of-the-technological-change-on-the-economy](https://www.researchgate.net/figure/251631233_fig2_Fig-2-Schumpeter-waves-of-impact-of-the-technological-change-on-the-economy)

Schumpeter as the first in history of economy formulated six cases coming out innovation combinations:

1. Launched a new product or with new quantities product.
2. Launched a new kind of production or technological processes
3. Create a new market target group
4. Make up a new sources of industry.
5. Launched a new industry organizations<sup>3</sup>.

<sup>1</sup> Białoń L., *Zarządzanie działalnością innowacyjną*, Placet, Warszawa 2010

<sup>2</sup> Białoń L., *Zarządzanie działalnością innowacyjną*, Placet, Warszawa 2010

<sup>3</sup> Schumpeter J., *Teoria wzrostu gospodarczego*, PWN, Warszawa 1960, s. 64.

Coming up that fifth cases Schumpeter connected with “creative destruction” implicated to start up a new, more effective structures.

Change is common connotation in each definitions of innovations. This terms aren't equal in meaning, meaning set of “change” is contain meaning subset of “innovation” , each innovation is change but not each change is innovation<sup>4</sup>.

Switalski pointed on attributes, which coming out can be taken for innovations:

- a) innovations as a effect of change witch modified or introduced quite new elements to ways or results of working some entity;
- b) change which comings across as innovation by some entity, should be introduced consciously, intently and lastingly;
- c) innovations is a change making:
  - o more effective entities working, or
  - o increased performance working entities usefull,
- d) more effective entities working evince as:
  - o lover administrative periodic cost beared in time unit for entity, or;
  - o shorter reaction time for environmental changing (external stimuli),
- e) increase usefully entity working performance (products or services) could be evince as:
  - o higher used or technical performance quality, simultaneously reserving using cost;
  - o lover used performing cost, equally reserving quality;
  - o proportion quality to using cost worked out after introduce change;
- f) change should be able to become common among other similar entities, which zeitgeist do not provide changes with similarly characterises<sup>5</sup>.

### 3. INNOVATIONS VS RES

The first criterion of division shall be an item which is innovative – in this case we differentiate among new qualities in the scope of production, technology, organisation, society and marketing. When the subject of innovation is a product, this means a new product is created, so far unknown, or a product with significantly changed properties of a subject or service. In technology it concerns a complete or partial change of factors and/or properties of manufacturing processes and the proportion between them. In the case of organisational changes we also encounter partial or complete changes. The s innovations concern the changes of incentive systems and organisational culture. In the field of marketing, we talk about the changes of concept and techniques of maintaining the Company's positive image. One may say that RES concern all of the aforementioned areas except production – we are still having to deal with known types of energy (electricity, heat); however, the very manner of producing energy is changing, there is a change in the organisation of using natural sources – from transferable to untransferable, new manufacturing processes are being created, but also we observe social changes in the scope of raising ecological awareness and a manner of conducting activities by humans (energy sources management processes and sources of obtaining energy).

Taking the scope of changes into account, one can distinguish among large innovations (break-through), medium (incremental) and small (incremental). The large innovations – the so-called break-through innovations, also called epoch-making innovations – are the effect of research and development, they may entail change of the entire branch of economy. The medium innovations – incremental – refer to, for instance, the emergence of a modernised product or technology which lead to changes in the nature of enterprises.. The small innovations – also incremental – also refer to the improvement of quality and functionality of the products, they shape innovation culture and have significant meaning in the activities of enterprises; however, they do not directly affect their nature.

Another systematising criterion is the originality level of implemented changes. In the literature on the subject one can distinguish creative, imitating and apparent innovations. The first of them implement a completely new state of affairs or processes, they usually originate due to research and development. They affect the establishment of companies and new branches of economy. The imitating innovations concern acquiring and extending the previously created processes as well as organisational manners

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<sup>4</sup>Białoń L., *Zarządzanie działalnością innowacyjną*, P lacet, Warszawa 2010

<sup>5</sup> Świtalski W., *Innowacje i konkurencyjność*, Wyd. WUW, Warszawa 2005, s. 68–69.

to further companies. In fact, the apparent innovations are not innovations but rather small changes used for marketing purposes and they repeatedly mislead prospective users.

In my opinion, renewable energy sources, at this point in time and at the current technological level, do not belong to epoch-making changes in the scope of the sources of obtaining energy– the amount of energy which became available can result in lowering demand for renewable energy; however, it turns out to be insufficient in order to cover total energy needs. In the future, it is possible that changes arising as a result of research and development will be created.

The binding and isolating innovations concern the level of complexity. The creation of the binding innovations is associated with the formation of technological, organisational and product changes. They result in the necessity of applying modifications not only in the place of their formation but also, importantly, they are applied in new areas. The isolating innovations do not entail the necessity of implementing innovations in new areas. Bearing in mind RES, we encounter mainly the isolating innovations.

Taking the financing methods into account, one can distinguish among the investing method, that is those referring usually to large and medium changes, and the product and technological methods. They are usually covered by the investment funds. Secondly, we have the non-investment methods. Their expenditures are covered by the costs of small changes and modernisation. In the case of renewable energy sources, according to user, this would be both the high-cost investments, as is manifested by the expenditures of the EU and current investments which result from the necessity of applying modernisation and changes in power stations and installations.

Taking into account attitudes towards environment one can distinguish among pro-environmentally (eco-investments) neutral and disturbing the ecological balance. The former aim to lower the use of materials, improve the condition of atmospheric air, water and ground. They also relate to marketing ecological products; therefore, they contribute to the modification of technology. The neutral innovations do not affect the environment. The latter – disturbing the ecological balance – have negative influence on natural environment or some of its elements.

In the case of RES, considering the subject, the innovations usually belong to partial, medium and small in terms of scale. In the case of originality, distinguishing RES can be treated as the creative ones on global level and the imitating ones in the case of expanding RES.

According to Lidia Białoń, eco-investments deserve to be presented individually, at least due to five reasons:

1. hazards to the environment and the necessity of its protection have become a problem of the contemporary civilisation;
2. planning environmental protection actions need to be more pronounced, which is connected with the raising of ecological awareness and more pressure on ecological innovation;
3. due to the increasing number of norms regulating permitted levels of environmental pollutions, designing eco-innovation have clear reference points in determining the benefits of their implementation;
4. due to increased environmental destruction, some actions aiming at its protection require the coordination of works at the various economic levels (company, region, country) which involves also problems of financing such activities;
5. the growth of international role of pro-ecological movement require clear reactions and activities of different subjects at the level of implementing the innovation.

It may be assumed that the activities connected with renewable energy sources have influence on the creation of innovations through investments imposed on this branch, implemented regulations which concern spreading RES and aiming at the reduction of costs connected with obtaining energy but also willingness to take care of the environment.

#### **4. THE POLICY OF THE EUROPEAN UNION'S MEMBER STATES VS RENEWABLE ENERGY SOURCES (DO RES FIT INTO THIS POLICY?)**

The increase of the world population, fast development of the middle class, intensifying effect of greenhouse effect and the energy crisis that emerged are threatening the development of economies

and the world. Scientists and practitioners made an effort to eliminate waste and ineffective management of energy sources.

The use of renewable sources, such as photovoltaic system and biomass plantation require adequate amount of space to absorb solar radiation. This means that the total energy amount which can be obtained from these sources is limited. Simultaneously, the ground is used for the production of food. It was shown that in difficult conditions there is no sufficient amount of ground to meet the requirements connected with food and energy demands<sup>6</sup>, thus it is more prominent to support the improvement of efficiency in the scope of RES.

The plan of the European Union to cover energy demand resulted in the formation of legal framework in particular Member states in the scope of the development of markets and supporting different areas and the direction of using renewable energy<sup>7</sup>.

The European Union set targets with regard to energy which shall be reached by 2020, 2030 and 2050. By 2020 there shall occur:

- reduction of greenhouse gas emissions by at least 20 percentage in comparison to the levels of 1990
- costs of renewable energy in general consumption of energy– 20 percentage
- the improvement of energy efficiency by 20 percentage
- In subsequent years - by 2030:
- reduction of greenhouse gas emissions by 40 percentage
- costs of renewable energy in general consumption of energy– 27 percentage
- the improvement of energy efficiency by 27-30 percentage
- 15 percentage of energy in interconnections (that is 15 percentage of electricity generated in the EU can be transmitted to other countries of the EU).
- The goal which shall be obtained by 2050:
- reduction of greenhouse gas emissions by 80-95 percentage in comparison to the levels of 1990.
- According to information provided by the EU, there are chances that these goals will be reached by 2020, because
- during 1990–2012 greenhouse gas emissions was reduced by 18 percentage
- in 2012 the share of renewable energy amounted to 14.1 percentage. (in comparison to 8.5 % in 2005) it is estimated that by 2020 energy efficiency shall rise by 18-19 percentage. It is slightly lower than the desired goal which amounts to 20 percentage. However it can be achieved if Member States will implement all relevant EU legislation<sup>8</sup>.

The basic legal act regulating renewable energy sources (RES) in the European Union (EU) is Directive 2009/28/WE of the European Parliament and Council of 23 April 2009 on the promotion of the use of renewable energy. In accordance with article 288 of the Treaty on the Functioning of the European Union, the Directive binds, as to the result to be achieved, upon each Member State to which it is addressed, but leave to the national authorities the choice of form and methods. The principal function of the directive is harmonising the provisions of Member States<sup>9</sup>, correct and timely implementation of the national law are vital for them in order to take full effect – in the absence of adjusting the national law they rise particular legal consequences, both among the relation EU – Member State, as well as in the scope of the rights of an entity<sup>10</sup>.

In the light of the Treaty provisions, Member States can choose both form and methods of the implementation of a directive to the national law. Allowing Member States to choose between various

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<sup>6</sup>Nonhebel S., *Renewable energy and food supply: will there be enough land?*, Renewable and Sustainable Energy Reviews, Vol. 9, Issue 2, April 2005, pages 191–201

<sup>7</sup>Krawiec F., *Odnawialne źródła energii w świetle globalnego kryzysu energetycznego wybrane problemy*, Warsaw 2010

<sup>8</sup>[http://europa.eu/pol/ener/index\\_pl.htm](http://europa.eu/pol/ener/index_pl.htm)

<sup>9</sup>Bohdan A., Przybylska M., *Podstawy prawne odnawialnych źródeł energii gospodarki odpadami w Polsce*, Monografie Prawnicze, C.Ch. Beck 2015

<sup>10</sup> *ibid.*

options stems from respecting the sovereignty of particular Member States and it allows to take specific characteristics and economic, social and legal features deriving from internal realities<sup>11</sup>.

Each of the directives contain a clause determining its implementation. At the right time, Member States cannot use the argument of too short period for implementation stipulated in the directive's provisions for transposition to justify the absence of the implementation<sup>12</sup>.

In the event of failing to fulfil national goals in the scope of applying RES, one may expect imposing fine on particular member state<sup>13</sup>.

In order to achieve goals imposed by the European Union, Member States can apply the following measures, supporting systems and means of cooperation among particular Member States and third countries<sup>14</sup>.

Apart from the implementation of main goals, Directive 2009/28/WE impose on Member States a number of obligations which can accelerate and facilitate the implementation of main goals. These obligations include most notably: among others, adoption of national action plan in the scope of renewable energy sources<sup>15</sup>; reducing legislative and administrative barriers for RES, including facilitating the access from RES to electricity networks; an obligation to provide better access to information and trainings in the scope of RES;

The goals which are increasing in several stages by 2020, vary from one Member State to another – from 10% at Malta to 49% in Sweden and are set in such way that the average 20% in the EU shall be achieved in comparison to 1990<sup>16</sup>.

## **5. THE INFLUENCE OF RENEWABLE ENERGY SOURCES ON INNOVATIONS.**

In order to gather data concerning the influence of RES on the level of creating innovation I used data published on Eurostat website<sup>17</sup>. The analysis concerned the factors representing innovativeness, namely, research and development expenses and return from innovation. To factors related to ecological activity belonged the amount of ecological licenses and the amount of electricity generated from renewable energy sources. The examined model was verified as to financial outlays on R&D postponed in periods of one and two years. No significant relation between these factors was found. The absence of significant relation can be explained by the fact that outlay share due to R&D for the green energy part is a fraction of the outlays expenditure on R&D.

## **6. CONCLUSION**

The changes concerning RES are innovative in nature because they use previous scientific and technical discoveries in a new way, they implement new, already discovered qualities on a larger scale. There is a change of technological processes; there is a change of the organisation of using natural sources – from transferable to untransferable (such as solar energy). At the moment, at our technological and political level, they are not considered as epoch-making changes with regard to the use of renewable energy; however, in the future it is possible that such sort of changes will occur. In the case of renewable energy, depending on the user it will be both high-cost investments as well as current.

Due to the absence of any visible impact in the available figures data, pro-ecological politics of the European Union has an impact on innovativeness through:

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<sup>11</sup> *ibid.*

<sup>12</sup> *ibid.*

<sup>13</sup> *ibid.*

<sup>14</sup> Article 3 section 3 of Directive 2009/28/WE.

<sup>15</sup> Article 9 of Directive 2009/28/WE.

<sup>16</sup> *ibid.*

<sup>17</sup> <http://ec.europa.eu/eurostat/web/main/home>, and <http://ec.europa.eu/eurostat/data/database>, date of access 11 November 2015

- formation of new technologies and devices;
- spreading technology and creating conditions for implementation in places where until now it was impossible,
- the conducted scientific research and technological works contribute to the creation of new inventions and patents,
- spreading awareness within society.

The above analysis and research can represent a valuable contribution to the creation of new considerations and research processes consisting in gradualisation of factors relating to expenditures for particular areas of science/technology which have a direct connection to eco-technology and the number of created power stations and eco-technological patents.

## REFERENCE LIST

1. Bohdan A., Przybylska M., *Podstawy prawne odnawialnych źródeł energii gospodarki odpadami w Polsce*, Monografie Prawnicze, Wydawnictwo C.Ch. Beck, Warszawa 2015.
2. Gawlikowska – Fyk A., *Znaczenie polityki energetycznej w procesie integracji europejskiej*, Biuletyn Europejski, Wydawnictwo UMCS, Lublin 2011.
3. Andersen S.S., *Towards a Common EC Energy Policy* [w:] Andersen S.S., Eliassen K.A. (ed.) *Making Policy in Europe*, Sage Publication, Allen & Unwin, London 1994.
4. Andoura S., Hancher L., van der Woude M., *Towards a European Energy Community: A Policy Proposal*, Studies & Research 76, Note Europe 2010.
5. Białoń L., *Poziom techniczny a zatrudnienie w polskim przemyśle w układzie gałęziowym*, WPW, Warszawa 1976.
6. Biernakowski L., (w:) *Innowacje w przemyśle obronnym*, „Materiały i Studia” Nr 108, WAP Warszawa 1984.
7. Biedrzycki J., Kozak M., *Rynek energii elektrycznej* [w:] Dobroczyńska A., (red.), *Energetyka w Unii Europejskiej. Droga do konkurencji na rynkach energii elektrycznej i gazu*, Prezes Urzędu Regulacji Energetyki, Biblioteka Regulatora, Warszawa 2003.
8. Buzek J., *Wspólna polityka energetyczna UE- ramy i działania* [w:] *Pytania o Europę. Opinie ekspertów*, Komisja Europejska – Przedstawicielstwo w Polsce, Warszawa 2010.
9. Cameron P.D., *Competition In Energy Markets: Law and regulation in the European Union*, Second edition, Oxford University Press, Oxford-New York 2007.
10. Dobroczyńska A., Juchniewicz L., *Polityka energetyczna Unii Europejskiej – nowa sytuacja* [w:] Kryńska E. (red.), *Tworzenie i realizacja polityki społeczno – ekonomicznej w Polsce. Aspekty teoretyczne i praktyczne*, tom I, Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2008.
11. Drucker P. F., *Innowacja i przedsiębiorczość: praktyka i zasady*, Wyd. PWE, Warszawa 1992, s. 29.
12. El-Agraa A. M., McGrowan F., *Energy Pilicy* [w:] El-Agra A. M. (Ed.), *The European Union. Economiscs and Policies*, 6<sup>th</sup> edition, Financial Times Prentice Hall, Harlow, New York 2001.
13. Elżanowski F., Będkowski-Kozioł M., Skoczny T., *Polityka energetyczna Unii Europejskiej* [w:] Jurkowska A., Skoczny T. (red.), *Polityki Unii Europejskiej: Polityki Sektorów Infrastrukturalnych*, Instytut Wydawniczy EuroPrawo, Warszawa 2010.
14. Evans D., *Western Energy Policy*, The Macmillian Press Ltd, London 1978.
15. Fiedor B., *Teoria innowacji: krytyczna analiza współczesnych koncepcji niemarksistowskich*, Wyd. PWN, Warszawa 1979, s. 31
16. Foster D.R., *Energy Crises and Western European Integration*, University of Colorado, 1995.
17. Freeman Ch., *The Economist of Industrial Innovation*, Pinter F., London 1982, s. 57.
18. Glachant J.M., Finon D., *Electricity and gas markets in Europe: Competition and Integration* [w:] Finon D., Midttun A. (eds.), *Reshaping of European Electricity and Gas Industry: Regulation, Markets and Business Strategies*, Research Report 2/2004, BI Norwegian School of Management, Sandvika 2004.
19. Górska M. E., Krzywicki T., *Wspieranie*
20. Haugland T., Bergsen H.O., Roland K., *Energy Structures and Enviromental Futures in Europe*, Oxford University Press, New York 1998.
21. Hrynkiewicz A., *Energia. Wyzwanie XXI wieku*, Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków 2002.
22. Kotler Ph., *Marketing: Analiza, uwarunkowania, wdrażanie, kontrola*, Wyd. Gebethner i S-ka, Warszawa 1994, s. 322.
23. Kotler Ph., Trias de Bes F, *Marketing lateralny*, Wyd. PWE, Warszawa 2005

24. Krawiec F., *Odnawialne źródła energii w świetle globalnego kryzysu energetycznego wybrane problemy*, Difin, Warszawa 2010
25. Kuznets S., *Six Lectures on Economic Growth*, Chicago 1959, s. 30. Cyt. za: Janasz W., *Determinanty działalności innowacyjnej przedsiębiorstw*, s. 13.
26. Mansfield E., *Industrial Research and Technological Innovation*, W. W. Norton, New York 1968, s. 83.
27. Marciniak S., *Innowacje i rozwój gospodarczy*, Wyd. KNSA PW, Warszawa 2000, s. 11–118.
28. Martin S., El-Agraa A.M., *Energy policy and energy markets* [w:] El-Agraa A.M., (ed.), *The European Union. Economics and Policies*, Eight edition, Cambridge University Press, Cambridge 2007.
29. Mauborgne W. Ch. Kim., R., *Strategie błękitnego Oceanu*, Wyd. MT Biznes 2005, s. 37.
30. McGowan F., *The Single Energy Market and Energy Policy: Conflicting Agendas?*, "Energy Policy", Vol. 17, Issue 6, December 1989.
31. Menrad K., *Innovation in the food industry in Germany*, *Research Policy*, Vol. 33/2004, s. 845–878,
32. Motowidlak T., *Efekty wdrażania polityki energetycznej Unii Europejskiej w zakresie wewnętrznego rynku energii elektrycznej*, Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2010.
33. Neuhoff K., *Large-Scale Deployment of Renewables for Electricity Generation* [w:] Helm D. (ed.), *The New Energy Paradigm*, Oxford University Press, Oxford 2007.
34. Pasieczny L., Więckowski J., *Ekonomika przedsiębiorstwa*, Wyd. PWE, Warszawa 1981, s. 136.
35. Pietrasziński Z., *Ogólne i psychologiczne zagadnienia innowacji*, Wyd. PWN, Warszawa 1970, s. 9.
36. Pomykański A., *Zarządzanie innowacjami*, Wyd. PWN, Warszawa 2001, s. 17.
37. Sosnowska A., (w:) *Jak wdrażać innowacje technologiczne w firmie*, Wyd. PARP 2005
38. Christensen C. M., Raynor M. E., *Innowacje – napęd wzrostu*, Wyd. Emka, Warszawa 2008
39. Świtalski W., *Innowacje i konkurencyjność*, Wyd. WUW, Warszawa 2005
40. Belin H., *Renewable Energy. Road map to reach 20% target for renewable energy by 2020*, "Europolitics Energy", No 704, 2007.
41. Belyi A.V., *New Dimensions of Energy Security of the Enlarging EU and Their Impact on Relations with Russia*, "European Integration", Vol. 25, Issue 4, December 2003.
42. Costantini V., Crespi F., *Public policies for a sustainable energy sector: regulation, diversity and fostering of innovation*, *Journal of Evolutionary Economics*, Apr2013, Vol. 23 Issue 2, p401-429
43. de Graaf, "Fragmentation in Global Energy Governance: Explaining the Creation of IRENA."
44. Drucker P.F., *Dyscyplina w podejściu do innowacji*, „Harvard Business Review Polska” Nr 1/2004 oraz *Innowacje i przedsiębiorczość*, Wyd. PWE, Warszawa 1992.
45. Helm D., *European Energy Policy: Securing supplies and meeting the challenges of climate change*, Paper prepared for the British Presidency in the EU, Oxford 2005, [http://www.fco.gov.uk/Files/kfile/PN%20papers\\_%20energy.pdf#search=%22Securing%20Supplies%20and%20Meeting%20the%20Challenge%20of%20Climate%20Change%22/](http://www.fco.gov.uk/Files/kfile/PN%20papers_%20energy.pdf#search=%22Securing%20Supplies%20and%20Meeting%20the%20Challenge%20of%20Climate%20Change%22/).
46. Ney R. *Uwarunkowania wykorzystania energii odnawialnej jako czynnika zrównoważonego rozwoju energetyki. Polityka Energetyczna* 7(1): 5-36, 2004.
47. Nonhebel S., *Renewable energy and food supply: will there be enough land?*, *Renewable and Sustainable Energy Reviews*, Vol. 9, Issue 2, April 2005, s. 191–201
48. *Renewable Energy Technology Roadmap 20% by 2020*. [dok. elektr.] EREC 2008 [http://www.erec.org/fileadmin/erec\\_docs/Documents/Publications/Renewable\\_Energy\\_Technology\\_Roadmap.pdf](http://www.erec.org/fileadmin/erec_docs/Documents/Publications/Renewable_Energy_Technology_Roadmap.pdf)
49. Safian R., *Twelve innovation lessons for 2014*, *Fast Company*. Mar2014, Issue 183, p20-22. 2p. 2 Color Photographs, 1 Black and White Photograph.
50. Saygin D., Kempener R., Wagner N., Ayuso M., Gielen D., *The Implications for Renewable Energy Innovation of Doubling the Share of Renewables in the Global Energy Mix between 2010 and 2030*. *Energies* (19961073) 2015, Vol. 8 Issue 6, p5828-5865. 38p.
51. Subtil L., Van den Bergh J. C. J. M., *International Diffusion of Renewable Energy Innovations: Lessons from the Lead Markets for Wind Power in China, Germany and USA*, *Energies*, 2014, Vol. 7 Issue 12, p8236-8263. 28p. 5 Charts, 4 Graphs.
52. Stryjecki M., *Produkcja energii z OZE jako inwestycja celu publicznego*, *Czysta Energia* 1: 12-13, 2009
53. *The measurement of scientific and technological activities. Proposal Guidelines for collecting and interpreting innovation data*, Oslo Manual, Third edition, 2005, s. 31.

54. Whitfield P. R., *Innowacje w przemyśle*, PWE, Warszawa 1979
55. Wüstenhagen R., Wolsink M., Bürer M. J., *Social acceptance of renewable energy innovation: An introduction to the concept*, Energy Policy, Volume 35, Issue 5, May 2007, Pages 2683–2691
56. Maxwell I. E., *Managing Sustainable Innovation*, Renewable Energy Innovation, p 81-95, February 2009.
57. Johnstone N., Hašič I., *Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts*, Environmental and Resource Economics, Volume 45, Issue 1, p 133-155, January 2010
58. Tawney L., Miller M., Bazilian M., *Innovation for sustainable energy from a pro-poor perspective*, Climate Policy (Earthscan). Jan2015, Vol. 15 Issue 1, p146-162. 17p.
59. *BP Statistical Review of World Energy*, British Petroleum, London 2010
60. Eurostat
61. [http://europa.eu/pol/ener/index\\_pl.htm](http://europa.eu/pol/ener/index_pl.htm)