

Energy Sector Modernization vs a Change in the Role of Renewable Energy Sources

INTRODUCTION

Realization of the aims assumed by the EU climate and energy package is one of the most significant factors affecting the range and direction of energy sector modernization in the EU countries. Meeting these aims would contribute to the protection of climate against adverse effects of the implemented energy policy as well as to the increased competitiveness of the EU economies. The aims of the package include:

- to reduce emissions of CO₂ by 20% as compared with the level in 1990;
- to increase the percentage of renewable energy sources in the structure of primary energy sources to 20%;
- to improve energy efficiency to save 20% of EU energy consumption by 2020.

Reaching these targets entails that the EU countries meet some detailed aims related to their energy sectors¹. When specifying these aims for individual EU countries, their local conditions were taken into careful consideration in order to minimize the negative impact of the package's aims on the development of their economies as well as on the standard of living of their residents. The necessity to minimize these adverse effects is of paramount importance now, in the face of the ever-expanding global economic crisis².

Meeting the targets assumed by the EU climate and energy package constitutes a considerable challenge for the energy sector in Poland. The Polish energy sector did not undergo any significant modifications during the past years and, therefore, neither the way it functions, nor the structure of primary energy

¹ The aims of the EU climate and energy package as well as its influence on the Polish economy are discussed in detail by [Frączek, 2010].

² The European Commission is willing to take steps in order to reduce emissions of CO₂ even by 30%, provided that other countries commit themselves to reducing emissions to a similar extent. Without the lack of such commitment on part of other countries, the costly modernization activities initiated by the EU states would only undermine the competitive position of these states.

sources still based on hard coal, conform to the modern standards. The experience of other countries which, by means of a conscious energy policy, have successfully modified their energy sectors, may serve as an important facilitation contributing to the modernization of the energy sector in Poland. The energy sector in Sweden, being a part of Nordic energy market, is a good example of such a successful transformation completed thanks to consistent and effective actions initiated by the state as well as thanks to a social support. The changes adopted enabled the state to create conditions conducive to leading a balanced energy policy. The solutions adopted in Sweden may serve as an example for other countries to follow.

The purpose of this paper is to describe how Sweden transformed its structure of primary energy sources, with particular emphasis on increasing the role of renewable energy sources (RES), as well as to suggest some ways of using this Swedish experience in order to modernize the energy sector in Poland and to meet the aims of the UE climate and energy package.

MODERNIZATION OF THE ENERGY SECTOR IN SWEDEN

Sweden does not have its own resources of hard coal, natural gas or oil. Therefore, in the past its energy sector was based on the import of energy sources. However, this country has got favorable conditions for the development of hydropower and for using biomass as a significant source of primary energy.

Nowadays, the Swedish energy policy is aimed at following the principles of balanced and sustainable development as well as at a long-term vision of increasing the role of renewable energy sources in the structure of primary energy sources. Also, due to the experiences related to the oil crisis, a great emphasis is placed on ensuring the energy security.

As a result of modernization of the energy sector in Sweden, the proportions of conventional fuels have been reduced in favor of renewable energy sources (RES) (mainly biomass and hydropower) as well as nuclear power (fig. 1.).

Particularly rapid changes in the energy sector were triggered by the oil crisis in the 1970s and the related sudden increase in oil prices. This has made both the decision makers and the entire society aware of the great importance of energy and its influence on the standard of living as well as on the country's economy. This crisis necessitated certain actions aimed at increasing the country's energy security and the introduction of modifications to the structure of primary energy sources. There were also initiatives aimed at diversifying the suppliers of energy sources.

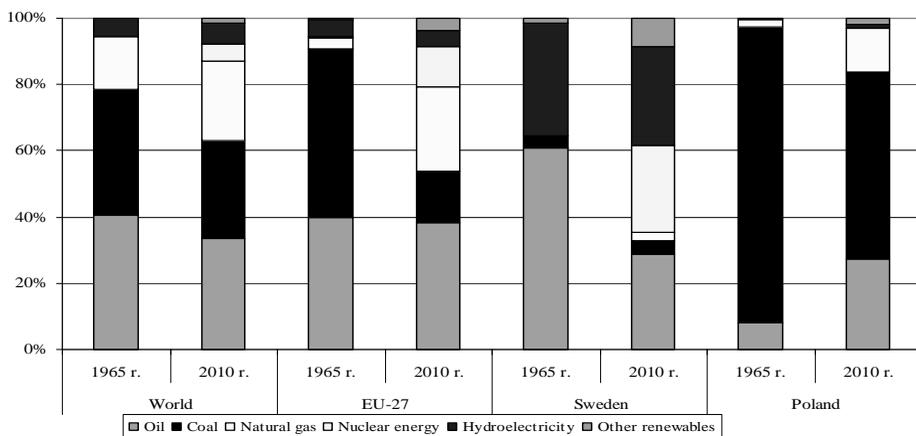


Figure 1. The structure of primary energy consumption in selected countries in 1965 and 2010

Source: BP, 2011.

Modernization of the Swedish energy sector was implemented in the following stages:

- increasing the potential of hydroelectric plants in the northern part of the country as early as in the 1930s,
- reducing the consumption of hard coal after the Second World War, when oil and hydropower became basic sources of energy,
- starting to build nuclear power plants in the 1960s,
- rapidly developing the nuclear power industry and renewable energy sources, biomass in particular, in the 1970s.

The development of hydropower was possible due to the favorable natural conditions as well as thanks to substantial investments in this field. As a result, Sweden has got one of the largest ratios of hydropower in the country's energy balance.

The processes of increasing the role of nuclear power and reducing the meaning of oil had their peaks in the years 1973–1997 and were triggered by the oil crisis. During this time, the percentage of oil dropped from 71% to 30%, whereas nuclear power increased from 1% to 36% [IAEA, 2000]. Reducing the role of oil in favor of nuclear power was related to the necessity to quickly meet the growing demand for energy in Sweden, as well as to initiatives aimed at reducing the country's dependence on the import of energy sources.

As was already mentioned, modernization of the energy sector in Sweden was also aimed at increasing the role of RES. In order to make them widely used, certain initiatives were undertaken, intended to combine waste manage-

ment with the energy policy by means of certain activities aimed at [Batóg, 2011; Ambasad..., 2011, Johansson, 2000]:

- developing a system of heating networks serving as distributors of heat produced from various sources,
- implementing certain solutions to the problem of waste sorting,
- popularize the practice of burning waste which thus becomes a source of electric energy and network heat.

In order to make it possible for waste to be burned at a large scale, Sweden placed considerable emphasis on building large incineration plants which are environmentally-friendly, as well as on expanding the heating networks powered by these plants. It is important that large incineration plants are equipped with high-performance filter systems which earned them social support³.

Systemic approach to waste management adopted by the individual Swedish municipalities entailed they were obliged to devise and implement waste management plans. Apart from specifying aims related to the issue of waste management, such plans were also supposed to propose ways of achieving these aims. Thanks to such an approach, the amount of waste and its destructive effects could be minimized and the environmental consequences related to waste management could be reduced. Also significant for waste management was the supervision of state institutions and introduction in 2002 of legal regulations prohibiting the storage of waste that can be recycled.

Due to combining the energy policy with waste management in Sweden, the country succeeded in reducing the scale of waste storage (only 3% of waste is stored, the rest is recycled). Some waste is also processed and, thanks to biological processes, can be used as a source of biogas.

An extremely significant aspect affecting the success of modernization of the energy sector in Sweden was also a considerable social support for nuclear energy and renewable energy sources as the ones that can ensure the country's energy security. The surveys conducted show that the Swedish society strongly approves of new technologies used in the energy industry, which, in future, can contribute to solving energy problems [*Energy...*, 2007].

The energy policy in Sweden contributes to the reduction of import of energy sources which now plays a less significant role in the structure of primary energy sources (in 2007 it was only 36.1%, whereas the average rate for the UE states was 53.1%) [EU, 2010]. It is also important that oil and hard coal imported to Sweden are now delivered from various countries which considerably reduces the risk of stoppage of supplies [IEA, 2008].

³ Incineration plants in Sweden are often located near large residential areas. However, due to the modern technological solutions used, they are not disturbing for the residents.

It needs to be emphasized that thanks to modernization of the energy sector in Sweden, conventional fuels play only a minor role in the structure of primary energy sources, which is a unique feature of this country as compared with other industrialized countries⁴. At the same time, Sweden is the only country in the world which simultaneously developed renewable energy sources and nuclear power. As a result of modernization, Sweden has got a balanced structure of primary energy sources which considerably enhances the country's energy security. It also needs to be stressed that Sweden has got the largest in the world proportion of RES in the structure of primary energy sources. According to the plans of the Swedish government encompassing the period until 2020, fossil fuels will not be used for heating. This will help to further reduce the emissions of greenhouse gases into the atmosphere.

Social support for modernization activities, particularly those aimed at increasing the role of RES and nuclear energy, was extremely important for the process of modernization of the energy sector in Sweden. The Swedish citizens expect their country to be perceived as environmentally-friendly and maintaining high technological and economic standards of its energy sector. Energy management is considered in Sweden to be one of the main aspects affecting the country's development. Thanks to modernization of the energy sector and a consistent energy policy, the role of oil was reduced in favor of renewable energy sources and nuclear power and, thus, the country's energy security was enhanced.

According to plans until 2020 (and compared with the year 1990), Sweden will reduce emissions of CO₂ by 40% and increase the proportion of renewable energy sources to 50%. Energy efficiency will grow by 20% and renewable energy sources will be used at a larger scale in transport, which is related to the requirements stated by the EU climate and energy package. Achieving these aims will necessitate the Swedish government to undertake further modernization initiatives.

The government's plan assumes the following [*Ministry...*, 2009]:

1. As regards the promotion of renewable energy sources:
 - improving the electricity certificate system and increasing the proportion of energy from RES,
 - establishing and implementing a national planning framework for wind farms located on land or offshore,
 - improving the conditions for connecting renewable electricity production to the electricity grid,
 - promoting the use of biogas in transport.

⁴ Among the conventional fuels, the largest role is played by oil which is mainly used in transport. In order to further reduce its role in the structure of primary energy in Sweden, there are initiatives aimed at increasing the use of renewable fuels in transport.

2. As regards the energy efficiency:
 - strengthening regional and local energy and climate initiatives,
 - increasing investment in information and advisory services as regards the energy efficiency,
 - popularizing good practices in public sector, related to the energy efficiency,
 - introducing support for enterprises that use considerable amounts of energy; this support will take the form of energy audits,
 - increasing the role of energy efficient technologies,
 - promoting the use of individual electricity meters.
3. As regards renewable fuels in transport:
 - exempting new “green cars” from vehicle tax and tightening the regulations specifying which vehicles could be considered “green”,
 - cooperating of various institutions in developing hybrid cars,
 - introducing subsidies to develop fuels based on RES,
 - specifying the criteria to be met by eco fuels,
 - regularly analyzing the consequences of using RES in the transport sector.

The current experiences drawn from modernization initiatives, the consistency of institutions engaged in this process, the support for modifications introduced as well as preparation of a detailed action plan demonstrate that the modernization activities mentioned above have every chance of successful implementation. This means that Sweden is likely to strengthen its leading position in implementing ecological solutions in the energy sector.

TAX POLICY VS INCREASING THE ROLE OF RES

Tax changes, tightening the regulations related to environment protection in Sweden as well as introducing the system of incentives for using RES, were some basic initiatives aimed at increasing the role of renewable energy sources. In the 1980s the tax policy in the energy sector in Sweden was focused on taxing oil in order to reduce its consumption. In order to precipitate the process of sector modernization, the tax reform related to the energy use was implemented in 1991. Its main effects were [Johansson, ([http1](#)); Johansson, ([http2](#))]:

- discontinuing oil tax, which used to be the main aim of tax policy in the energy sector in the 1980s, and, instead, introducing taxes aimed at reducing the consumption of fuels which produce carbon dioxide,
- apart from a general tax on energy carriers, introducing also a tax on CO₂ emissions,
- introducing tax reliefs for industrial recipients and energy producers in order to support their competitiveness; this contributed substantially to enhancing the position of the Swedish papermaking industry on the global markets,

- reducing the average rate of energy tax while increasing taxes on fossil fuels used for powering heating networks (the increase between 30–160%, depending on the type of fuel),
- deciding not to tax biofuels which considerably boosted their competitiveness,
- setting the prices for the individual energy carriers in such a way so that biomass becomes a competitive fuel for large heating systems.

The introduction of carbon taxes in Sweden reduced the price competitiveness of conventional fuels as it made it difficult to transfer external costs of using coal to other recipient groups [Lindhjem et al., 2009; Ptak, 2010]. Implementing such solutions resulted in reducing the role of hard coal in the country's energy balance and contributed substantially to the increased role of bioenergy in the energy balance. The tax solutions introduced in Sweden are also significantly reducing the emissions of greenhouse gases into the atmosphere.

CONCLUSIONS

Thanks to its energy policy, Sweden is one of the leaders as regards the initiatives aimed at reducing the scope of climate change related to energy management. The Swedish society expects the activities intended to lead a balanced energy policy, to be continued. This might be proved by the fact that in order to further reduce emissions of greenhouse gases, the Swedish authorities postulate to increase the required reduction percentage from 20% (as specified in the EU climate and energy package) to 30%.

The Swedish experiences drawn from modifying the structure of energy sources, especially the ones related to promoting RES, may be used in Poland in order to modernize its energy sector. It needs to be emphasized that in Sweden, attracting and maintaining social support for the initiatives planned as well as the necessity to increase the country's energy security, which reduced the role of the imported hard coal and oil, were conditions necessary for introducing changes in the energy sector.

Making the Swedish society aware of the importance of the energy sector for the competitiveness of the country's economy and for the standard of living also contributed to the increased role of this sector as well as to the implementation of certain modernization initiatives. Due to this social awareness and support for the implemented changes, Sweden can set an example to be followed by other countries intending to modernize their energy sectors.

Changes in the Swedish energy policy are also connected with the introduction of incineration plants which contributed to the development of heating net-

works. A large scale of the activities undertaken, reduced the cost per unit of producing electric energy. Emphasis placed on large incineration plants also minimized the ecological consequences of the initiatives and guaranteed social support for such solutions. A factor that considerably facilitated the popularization of biomass was the development of timber processing industry as well as heating networks.

It should be stressed that the system of waste management in Sweden may serve as an example for Poland to introduce a similar one. This could become an important facilitation for improving the waste management in our country as well as contribute to meeting the requirements in this area as specified by the EU climate and energy package. The necessity to introduce such a system in Poland is indicated by the 2008/98/EC directive.

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Summary

Meeting the targets assumed by the EU climate and energy package constitutes a considerable challenge for the energy sector in Poland. The Polish energy sector did not undergo any significant modifications during the past years and, therefore, neither the way it functions, nor the structure of primary energy sources still based on hard coal, conform to the modern standards. The experience of other countries which, by means of a conscious energy policy, have successfully modified their energy sectors, may serve as an important facilitation contributing to the modernization of the energy sector in Poland. The energy sector in Sweden, being a part of Nordic energy market, is a good example of such a successful transformation completed thanks to consistent and effective actions initiated by the state as well as thanks to a social support. The changes adopted enabled the state to create conditions conducive to leading a balanced energy policy. The solutions adopted in Sweden may serve as an example for other countries to follow.

The purpose of this paper is to describe how Sweden transformed its structure of primary energy sources, with particular emphasis on increasing the role of renewable energy sources (RES), as well as to suggest some ways of using this Swedish experience in order to modernize the energy sector in Poland and to meet the aims of the UE climate and energy package.

Modernizacja sektora energii a zmiana znaczenia odnawialnych źródeł energii

Streszczenie

Realizacja celów pakietu energetyczno-klimatycznego jest ogromnym wyzwaniem dla sektora energii w Polsce, który w minionych latach nie podlegał istotnym zmianom i z tego powodu jego funkcjonowanie oraz występująca w kraju oparta na węglu kamiennym struktura źródeł energii pierwotnej nie odpowiada współczesnym standardom w tej dziedzinie. Istotnym ułatwieniem dla realizacji działań służących modernizacji sektora energii w Polsce może być skorzystanie z doświadczeń krajów, które prowadząc świadomą politykę energetyczną, dokonały zmiany sposobu funkcjonowania swego sektora energii. Przykładem takiej udanej transformacji podejmowanej dzięki skutecznym i konsekwentnym działaniom instytucji państwa oraz poparciu społecznemu dla tych działań jest sektor energii w Szwecji funkcjonujący obecnie jako część nordyckiego rynku energii. W wyniku przeprowadzonych zmian udało się stworzyć warunki do prowadzenia zrównoważonej polityki energetycznej. Rozwiązania zastosowane w Szwecji mogą stanowić wzór dla innych krajów.

Celem opracowania jest przedstawienie doświadczeń Szwecji związanych ze zmianą struktury źródeł energii pierwotnej, w tym w szczególności zwiększaniu znaczenia OZE, oraz pokazanie jak te doświadczenia mogą zostać wykorzystane w Polsce dla modernizacji sektora energii, w tym w szczególności dla realizacji celów pakietu energetyczno-klimatycznego.