THE IMPACT OF SUPPORT SCHEMES APPLIED FOR ELECTRICITY PRODUCED FROM RENEWABLE ENERGY SOURCES ON ELECTRICITY PRICES IN THE BALTIC STATES

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Overview

Increased production and use of electricity from renewable sources (RES-E) is recognized as a relevant measure, which is essential to reduce greenhouse gas emissions, promote security of energy supply, technological development and innovation [1]. It is also relevant to increase employment and economic growth [2]; as well to keep competitive prices [1]. Yet the RES-E and economy nexus is under the consideration. Thus far the greatest attention is directed in discovering and assessing the relationship between increased production volume of RES-E and prices of electricity at wholesale and retail levels [3-10], since this allows substantiating expedience of RES-E from the economic point of view. Presently, this issue was discussed in details in countries, which historically had stable and consistent RES-E support policies and achieved good results [7; 9-10], while was little analysed in countries with frequently alternating and sometimes with shortcomings RES-E support policies. This is the case of Baltic States, the domestic electricity markets of which, moreover, is specific, each depending on different domestic resources or relying on electricity import from neighbouring countries [11], achieving different level of national electricity markets liberalization and undergoing integration of electricity networks within the EU.

Methods

Literature analysis method is applied seeking to disclose scientific information known about the role of RES-E in formation of electricity prices at wholesale and retail levels; as well to analyze legal acts regulating RES-E sector development in the Baltic States. A multivariate regression method (described in [6]) is applied to assess the relationships between increased production volume of RES-E and electricity prices in the Baltic States. The advantage of the method is that it allows explaining the impact of production volume of RES-E in the context of a set of various economic, environmental, technological, social, seasonal and other factors. Thus, the method can be also used to explain electricity price formation process in the Baltic States. Since electricity price is influenced by general and country-specific factors; as well cross-border limitations create preconditions for formation of different price zones, therefore three expressions of multivariate regression models are prepared, one for each country. A multivariate regression model for formation of electricity price in Lithuania acquires a form of Eq. (1):

$$lnPRICE_t = \beta_0 + \beta_1 \cdot lnWIND_t + \beta_2 \cdot lnIMPORT_{LVt} + \beta_3 \cdot lnIMPORT_{RUt} + \beta_4 \cdot lnIMPORT_{BYt} + \beta_5 \cdot lnDEMAND_t + \beta_7 \cdot DD_{tk} + \beta_8 \cdot MD_{tl} + \varepsilon \quad (1)$$

Formation of electricity price in Latvia is described by Eq. (2):

$$lnPRICE_t = \beta_0 + \beta_1 \cdot lnRES_{smallt} + \beta_2 \cdot lnHYDRO_t + \beta_3 \cdot lnWIND_t + \beta_4 \cdot lnTHERMAL_t + \beta_5 \cdot ln(EXPORT_t - IMPORT_t) + \beta_6 \cdot lnDEMAND_t + \beta_7 \cdot DD_{tk} + \beta_8 \cdot MD_{tl} + \varepsilon \quad (2)$$

Formation of electricity price in Estonia is described by Eq. (3):

$$lnPRICE_t = \beta_0 + \beta_1 \cdot lnWIND_t + \beta_2 \cdot lnEXPORT_{FIt} + \beta_3 \cdot lnIMPORT_{RUt} + \beta_4 \cdot lnIMPORT_{LVt} + \beta_5 \cdot lnDEMAND_t + \beta_7 \cdot DD_{tk} + \beta_8 \cdot MD_{tl} + \varepsilon \quad (3)$$

here: *ln* - natural logarithm; $PRICE_t$ - average day-ahead electricity price; *t*- time moment; $WIND_t$ - average hourly production volume of wind electricity; $HYDRO_t$ - average hourly production volume of hydro electricity; $THERMAL_t$ - average hourly production volume of thermal electricity; $EXPORT_t$ - average hourly electricity export volume; $IMPORT_{LVt}$ - average hourly electricity import volume from Latvia; $IMPORT_{RUt}$ - average hourly electricity import volume from Russia; $IMPORT_{FIt}$ - average hourly electricity import volume from Finland; $IMPORT_{BYt}$ - average hourly electricity import volume from Belarus; $DEMAND_t$ - electricity consumption volume at a certain price; DD_{tk} - daily dummies (*k=1, 2,...6*), MD_{tl} - monthly dummies (*l=1, 2,...11*).

Segregation method is used to disclose the structure of electricity price for final electricity consumer and show the share of support to RES-E in the retail price structure. Comparison of changes of day-ahead and retail electricity prices is done to disclose actual benefits of price changes for final electricity consumers.

Results

Results of the literature analysis disclose strong sides and shortcomings of RES-E support schemes applied in the Baltic States; as well they display a day-ahead electricity price formation process and the role of RES-E in it. Regression models prepared for three Baltic States enable to assess the relationship between day-ahead electricity prices and identified fundamental and seasonal electricity price factors. The results of regression analysis reveal that a day-ahead electricity price increases due to increasing domestic and foreign demand of electricity, whereas it decreases when cheap import from electricity surplus neighboring markets is available. Calculated elasticity coefficients of a day-ahead electricity price to volume of electricity produced in wind power plants reports a negative relationship between variables in the Baltic States. It is assessed that if production volume of wind electricity increases by 1%, then a day-ahead electricity price decreases by 4.1% in Estonia. Elasticity coefficients of a day-ahead electricity price to volume of wind electricity is (-4.7) in Latvia and (-5.0) in Lithuania. Explanatory power of developed regression models increases when in addition to fundamental factors seasonal variables are included. The results of regression models with seasonal variables show that a day-ahead electricity price has a tendency to increase in summer. Thus far final electricity consumers remain RES-E supporters, since support included in final electricity price is higher than wholesale electricity price reductions acquired due to increased volume of wind electricity.

Conclusions

Due to its possibility to reduce electricity price increases in wholesale electricity markets, production of RES-E should be welcomed in the Baltic States. Thus, integration of RES-E into the markets is valuable from this point of view; and consistent and long-term RES-E support policy and related measures are essential. However, support to RES-E should be provided based on economically substantiated criteria taken into account actual market conditions. This could contribute to achievement of real benefits - reduced electricity prices for final electricity consumers. Implementation of strategic electricity network projects and physical integration of the Baltic States into the EU energy systems, is necessary, since this will create preconditions for electricity trade and import of electricity (including RES-E) from neighboring countries at competitive prices.

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