



Energy Transition Index and World Energy Trilemma Index as an energy transition's pace measure for policy-making using the example of Poland

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Abstract: The monitoring of the energy transition is a complex and complicated process due to its nature, which involves many technical, economic, social and environmental aspects. Thus, it is challenging to create a numerical measure to describe each country's progress in implementing the energy transition. The aim of this article is to characterise the Energy Transition Index and World Energy Trilemma Index, and present their results, together with a discussion of Poland's position in comparison with other countries. The above-mentioned indicators are globally acceptable and reliable measures of the pace and progress of the energy transition. The use of energy transition metrics is a useful tool to facilitate decision-making in the area of energy and climate policy. Nevertheless, it must be stressed policy-making must not rely just on indicators without a deeper understanding of given index and their methodology. The individual context of a country is a key factor to understand the indicator of energy transition's pace, thus the importance of this component of the index should be increased. Poland's position in both rankings is relatively low, especially when compared to countries in the Central-Eastern Europe region. The main reasons for the low ratings are the dependence on coal and the need for decarbonisation, the low share of RES generation and the low flexibility of the electric power system.

Key words: Energy transition, Energy Transition Index, World Energy Trilemma Index, energy policy, policy-making

Introduction

The energy transition is currently one of the biggest challenges facing not only the energy sector itself, but in the context of the entire economy. In addition, ongoing energy and climate policy in the European Union is making the transition to a zero-carbon economy a necessity. The decarbonisation of the economy is therefore becoming a key challenge to maintain the competitiveness of the economy and to meet increasingly strict environmental standards. Tackling climate change is becoming one of the main objectives of the European Union's energy policy.

Energy transition is becoming one of the key challenges for the Polish economy. Decarbonisation, the investment gap and exposure to climate risk are becoming key challenges for the energy sector in Poland, affecting both energy security and economic issues (Sobik, 2022, p. 15-16).

Verifying the progress of the energy transition is not easy because of the very broad significance of the economic transition and its many technical, economic, social and environmental aspects. In the paper (Kopeć, Lach, 2021, p. 133) two methodological options for verifying the progress of the energy transition have been presented:

- Reviewing the progress of the energy transition in different countries;
- Reviewing the progress of the energy transition for one country using a time series.

Globally, there are two indicators designed to verify the progress of the energy transition:

- Energy Transition Index (ETI);
- World Energy Trilemma Index (WETI).

The aim of this article is to characterise the above-mentioned indicators and present their results for 2021, together with a discussion of Poland's position in comparison with other countries. This will allow the progress of the energy transition in Poland to be assessed through objective factors and comparative analysis with other countries. The article uses data published in the Energy Transition Index and World Energy Trilemma Index reports for 2021.

Energy Transition Index

Energy Transition Index is an indicator published by World Economic Forum (WEF). It consists of two equal elements (World Economic Forum, 2021, p. 11):

- System performance;
- Transition readiness.

Sub-index system performance describes energy system performance with accordance to three major elements and twelve minor elements (World Economic Forum, 2021, p. 44):

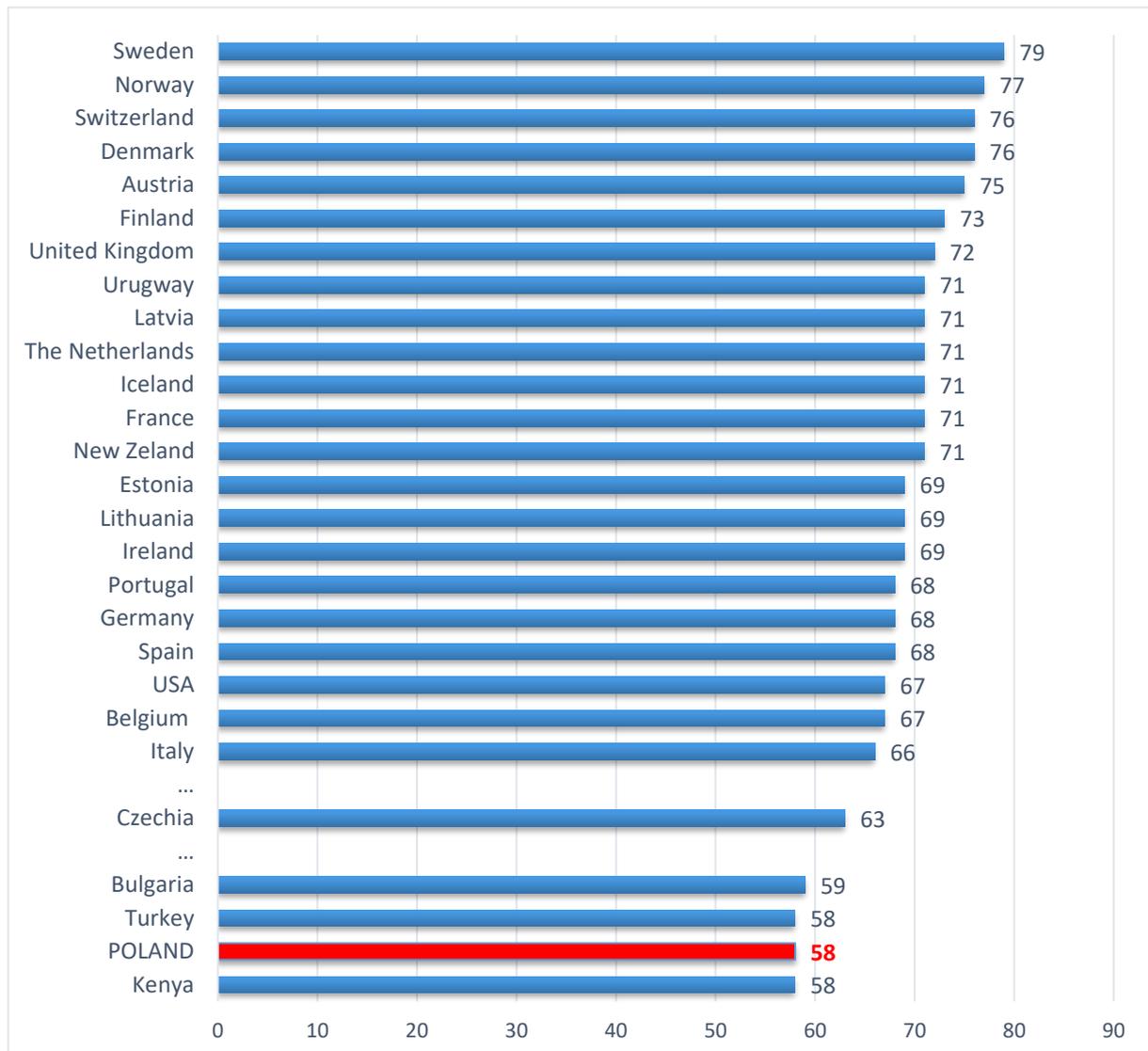
- Security and access:
 - Security of supply (50%);
 - Quality of supply (17%);
 - Energy access (33%);
- Environmental sustainability:
 - Carbon emissions per capita (25%);
 - Carbon intensity (25%);
 - Energy intensity (25%);
 - Air pollution (25%);
- Economic development and growth:
 - GDP contribution (20%);
 - Cost of externalities (20%);
 - Fossil fuel subsidies (20%);
 - Industry competitiveness (20%);
 - Affordability (20%).

Sub-index transition readiness consists of 6 equal major elements and 17 minor elements (Ibidem):

- Energy System Structure:
 - Fossil fuel dependency (20%);
 - Electricity mix (60%);
 - Energy demand growth (20%);
- Human Capital and Consumer Participation:
 - Jobs in Renewable Energy Sector (50%);
 - Quality of education (50%);
- Infrastructure and innovative business environment:
 - Innovative business environment (33%);
 - Transportation infrastructure (33%);

- Trade logistics (33%);
- Institutions and governance:
 - Stable finances (33%);
 - Rule of law (33%);
 - Transparency and political stability (33%);
- Regulation and political commitment:
 - Regulation to support electric energy, renewable energy sources and access to energy (60%);
 - Stable policy (20%);
 - Commitment to international agreements (20%);
- Capital and investment:
 - Recent investment into renewable energy sources (33%);
 - Access to capital (33%);
 - Ability to invest (33%).

The Energy Transition Index provides a variety of variables and energy indicators, being a useful information tool (Singh et al., 2019, p. 4). Results of the Energy Transition Index as for 2021 are presented in the fig. 1.

Fig. 1. Energy Transition Index in 2021 (not all countries)

Source: Own research based on (World Economic Forum, 2021).

The leading countries in the ETI ranking are Sweden, Norway and Switzerland. They received the highest scores in both the energy system efficiency and transition readiness categories. These countries are wealthy, have a diversified energy mix, make extensive use of RES, and are characterised by a high legal and institutional culture, and significant capital capabilities. Among countries belonging to the CEE (Central and Eastern Europe) region, Latvia was ranked highest with 71 points. Poland's low ranking indicates a number of challenges to be faced by the Polish economy and energy sector in the coming years. Analysing Poland's result in the ETI index study for 2021, it can be pointed out that this score of 57.74 is lower than the global average of 59.35. The components of Poland's score are the efficiency of the energy system, set at 63.7, and the readiness for transformation, which scored only 51.8 (World Economic Forum, 2022). This poor result of the transformation readiness sub-index is due to a very low score in the electricity system structure categories (24.60 against a global average of 68.45), which was mainly influenced by low scores for the flexibility of the electric power system (11.29 against a global average of 64.95) and the share of RES in the energy mix (15.29

against a global average of 38.43) (Ibidem). The results therefore indicate difficulties with the flexibility of the National Electricity System, which is largely related to the reliance on coal-fired power generation, which is an inflexible energy source. They also illustrate the insufficient development of RES. The above results highlight the issue of the structure of the National Power System, which will be a major challenge in implementing the energy transition in Poland.

World Energy Trilemma Index

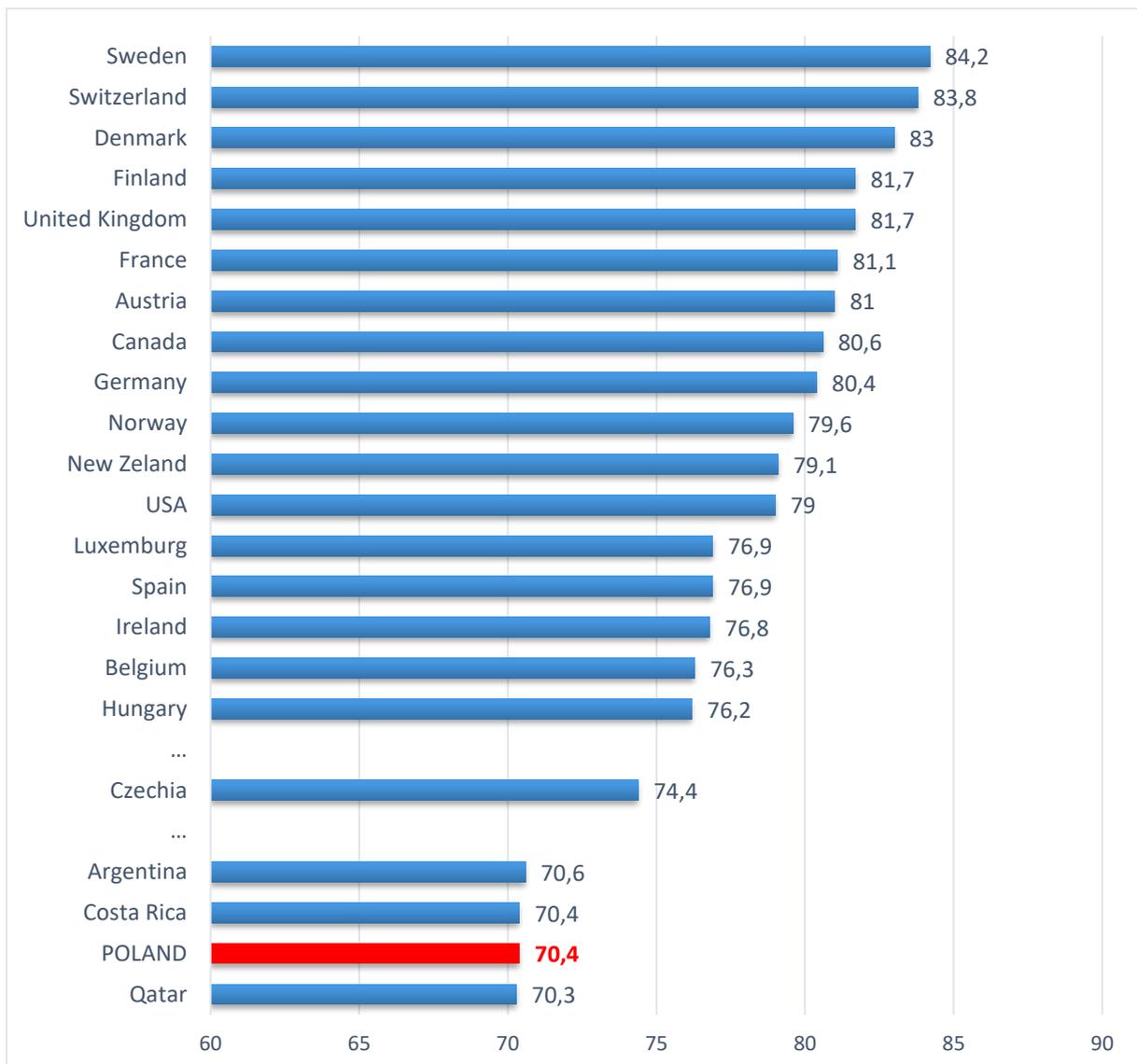
World Energy Trilemma Index (WETI) is an indicator published by World Energy Council (WEC). It consists of four main sub-indexes, which consist of minor elements (World Energy Council, 2021, p. 61):

- Energy security (30%):
 - Diversity of primary energy supply (6%);
 - Import independence (6%);
 - Diversity of electricity generation (6%);
 - Energy storage (6%);
 - System stability and recovery capacity (6%).
- Energy equity (30%):
 - Access to electricity (6%);
 - Access to clean cooking (6%);
 - Access to “modern” energy (6%);
 - Electricity prices (3%);
 - Gasoline and diesel prices (3%);
 - Natural gas prices (3%);
 - Affordability of electricity for residents (3%).
- Environmental sustainability (30%):
 - Final energy intensity (5%);
 - Efficiency of power generation, transmission and distribution (5%);
 - Trend of greenhouse gas emissions from energy sector (5%);
 - Low carbon electricity generation (5%);
 - CO₂ intensity (2%);
 - CO₂ per capita (2%);
 - CH₄ emissions from energy sector per ktoe (1%);
 - PM_{2,5} mean annual exposure (5%).
- Country context (10%):
 - Macroeconomic stability (2%);
 - Effectiveness of government (1%);
 - Political stability (1%);
 - Rule of law (1%);
 - Regulatory quality (1%);
 - Foreign direct investments net inflows (1%);
 - Ease of doing business (1%);
 - Perception of corruption (0,5%);
 - Efficiency of legal framework in challenging regulation (0,5%);

- Intellectual property protection (0,5%);
- Innovation capacity (0,5%).

It is worth emphasising that this indicator refers to the Energy Trilemma concept, which indicates that energy sustainability consists of three key elements: energy security, energy equity and environmental sustainability (World Energy Council, 2021, p. 2). Thus, analysing WETI is a useful tool so as to monitor countries' contribution to energy security, energy equity and environmental sustainability (Asbahi et al., 2019, p. 705). In addition, the country context is also taken into account in the final outcome, which is important given the complexity of the energy transition issue and the large role of individual circumstances affecting each country individually. Results of the World Energy Trilemma Index as for 2021 are presented in the fig. 2.

Fig. 2. World Energy Trilemma Index in 2021 (not all countries)



Source: Own research based on (World Energy Council, 2022).

European countries are leading in the WETI ranking, led by Sweden, Switzerland and Denmark. They scored highly in all three main categories: energy security, energy equity and environmental sustainability. Of the CEE countries, Hungary ranked highest with a score of 76.2

points, mainly thanks to its 12th place in the energy security index. Poland scored 70.4 points, ex aequo with Costa Rica, which placed it 30th. The individual component indices for Poland were: energy security 64.2 points and energy sustainability 61.6 points (World Energy Council, 2022). Poland's quite low ranking was mainly influenced by low scores for diversification of the energy mix and low generation from low- and zero-carbon sources. Thus, the index confirmed the problem of low generation from RES and low-carbon sources and pointed to the need to diversify and decarbonise the electricity generation structure. Also in this ranking, Poland ranked rather distantly from other countries in the CEE region (last place among the CEE EU Member States).

Conclusions

Monitoring the energy transition is a complex and complicated process due to the nature of the transition - it affects many aspects of the economy, society and the environment. For this reason, making direct comparisons between countries is difficult (Yu et al., 2020, p. 2). The conclusion can therefore be reached that it is necessary to increase the role of country context in measuring the progress of the energy transition. The problem of monitoring complex and interdisciplinary processes means that precise quantitative measurements related to the analysis of the progress of the transition cannot be made in an unambiguously objective manner, as numerous simplifications, assumptions and approximations will have to be made. Nevertheless, the indicators presented in this publication are globally acceptable and reliable measures of the pace and progress of the energy transition. The use of energy transition metrics is a useful tool to facilitate decision-making in the area of energy and climate policy. Nevertheless, it must be stressed policy-making must not rely just on indicators without a deeper understanding of given index and their methodology (Šprajc et al., 2019, p. 8). As it was presented, the individual context of a country is a key factor to understand the ratio of energy transition.

Based on the analysis of the data presented in this article, it can be suggested that it is possible to increase the focus on the individual circumstances of each country. A long list of factors – ranging from political, geopolitical, geographical, social, economic and climatic – influence a country's current energy situation and its ability to make progress in the energy transition. Hence, countries differ in their starting point and therefore the outcome of their efforts varies, as indicated in the paper.

The results of the Energy Transition Index and World Energy Trilemma Index for Poland as for 2021 are low and indicate the main challenges for the implementation of the energy transition in Poland. Particularly highlighted are the issues of decarbonisation and the current dependence on coal, the too slow rate of RES development and insufficient flexibility of the electric power system. Poland's position in both rankings was one of the lowest among the CEE countries, indicating that the energy transition in Poland will require the greatest efforts among the countries in the region.

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