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AN OVERVIEW OF TURKIYE'S PROGRESS TOWARD SDG7 AND SDG13

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ABSTRACT
Purpose- This study aims to provide an overview of Turkiye's performance in energy use and climate change within the framework of Sustainable Goal 7 (SDG7) and Sustainable Devekopment Goal 13 (SDG13) between 2002 and 2022.
Methodology- To provide an overview of Turkiye's performance in energy use and climate change, Multi Criteria Decision Making (MCDM) approach was used. For this purpose, Additive Ratio ASsessment (ARAS) method was applied to the six different years, 2002, 2006, 2010, 2014, 2018 and 2022. In the analysis, indicators regarding energy use and climate change such as access to clean fuels and cooking technologies, energy intensity, energy imports, renewable energy and fossil fuel energy consumption, greenhouse gas (GHG) emissions were used and data set was emploted compiled from World Development Indicators Database.
Findings- When comparing the utility levels obtained from ARAS method it is observed that utility degrees decreased from 0.7767 to 0.7004 between 2002 and 2014, after that time, increased and it reached 0.8528 in 2022. While between 2006 and 2014 utility degrees are at the almost same level, after 2014 it is seen that the utility degree has rised to 0.8528. According to this, 2014 has the lowest performance level while 2022 has the highest level.
Conclusion- Findings indicated that although there have been positive developments in climate change policies in Turkiye, it is clear that there are still measures that need to be taken in this regard. Turkiye should continue to support investments and incentives to increase renewable energy consumption based on solar and wind power instead of fossil fuels to reduce carbon dioxide emission. Thus, all these efforts will not only prevent environmental degradation but also play an important role in reducing the deficit of the current account, which is one of the consequences of dependency on external energy sources.

Keywords: Energy use, environmental sustainability, climate change, ARAS, Turkiye.
JEL Codes: C44, Q40, Q54

1. INTRODUCTION

The greatest environmental disaster experienced today is global warming and the resulting climate change. Greenhouse gas (GHG) emission is the most significant factor leading to climate change throughout the world. It consists of different gases such as carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4). The negative effects of climate change cause unusual nature events in the last decades. Accordingly, drought, floods, forest fires, loss of biodiversity, extreme weather events, melting glaciers, food insecurity, rising sea levels, and increased health risks are the consequences of the climate change and global warming (UN, 2025a).

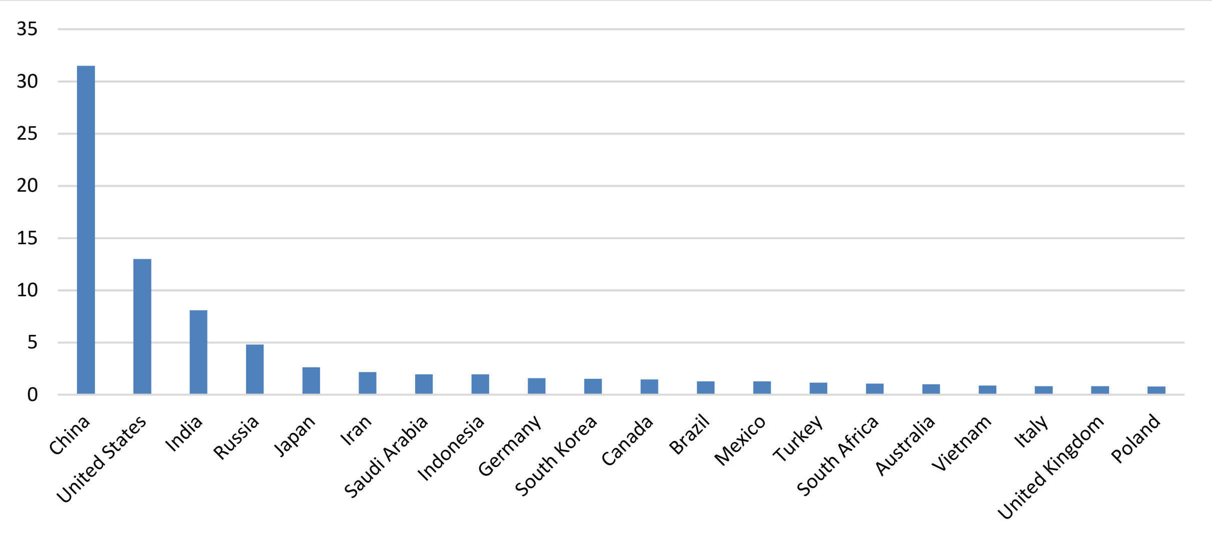
Sustainable Development Goals (SDGs) which were released by United Nations (UN) in 2015 includes 17 Goals. Among these goals SDG7 and SDG13 are related to energy use and impacts of climate change. SDG7 highlights importance of energy use, reliable, sustainable and modern energy sources while SDG13 highlights consequences of climate change on environmental sustainability. This Agenda also sets out 169 targets to be achieved by 2030, and countries' progress towards these targets has been tracked through related indicators.

The Paris Agreement, which was signed by 192 nations in 2015 and came into force in 2016, is an extension of efforts to protect environmental sustainability. The agreement's primary goal is to keep the rise in temperature to 1.5°C over pre-industrial levels. However, the effects of climate change have been getting worse, moreover according to the estimates, 2024 was almost 1.55°C over pre-industrial levels (UN, 2025b).

The Climate Change Performance Index (CCPI) is one of the most common indexes utilized for assessing how well countries perform in terms of environmental sustainability. The CCPI that is released by Germanwatch every year since 2015 assesses countries in terms of climate mitigation and this index has four main categories which are GHG emissions, renewable energy, energy use, and climate policy. A total score is calculated for each country based on four these categories and their indicators. Countries that have highest scores are rated as very high, while those with the lowest scores are rated as low. As of 2025, Turkiye ranks 53rd among 67 countries and is rated as "very low" (Burck et al., 2024). Also, Turkiye had previously been rated in 2018, 2019, and 2020. Moreover, in Environmental Performance Index 2024 Turkiye ranks 143rd among 180 countries (Block et al. 2024). When the countries that are rated as "very low" between 2018 and 2023 continuously are examined in CCPI, it is seen that these countries are the top global emitters of CO_2 in the world.

The top global emitters of CO_2 are shown in Figure 1. Accordingly, China is the top emitter of CO_2 and United States, India, Russia, Japan follow this country. Turkiye ranks 14th behind Mexico. Nearly half of global GHG emissions are caused by the top six polluters together (UN, 2025b).

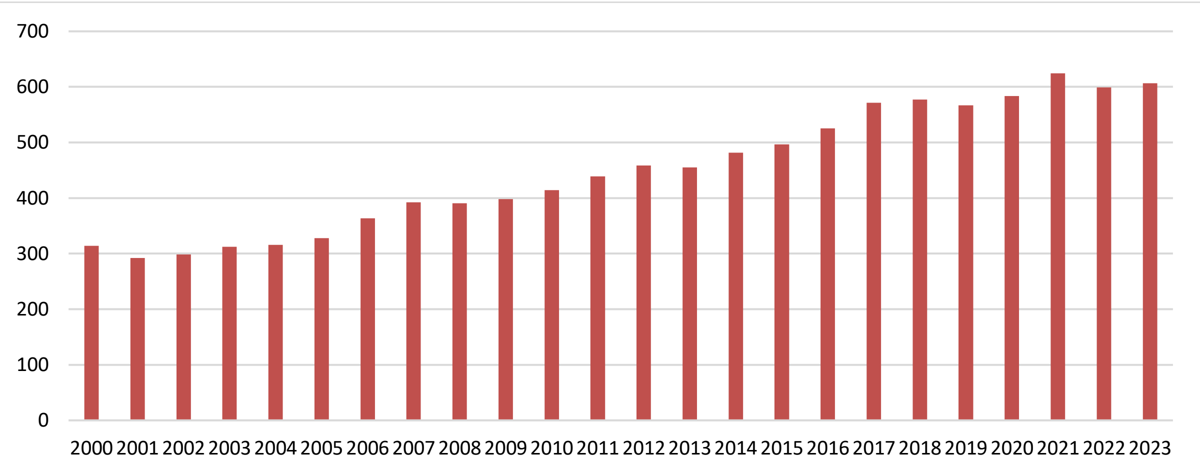
Figure 1: Top emitters of CO_2 worldwide as of 2023



Source: Statista, Greenhouse gas emissions worldwide 2024

Despite all efforts, GHG emissions are increasing in Turkiye, as they are worldwide. Figure 2 presents increase in GHG emissions in Turkiye in the last two decades. Between 2017 and 2025, 71.6% of the GHG emissions in Turkiye resulted from energy sector. (Turkish Statistical Institute, 2025; Sahin, 2019). This situation demonstrates how important and effective the energy sector is in preventing climate change.

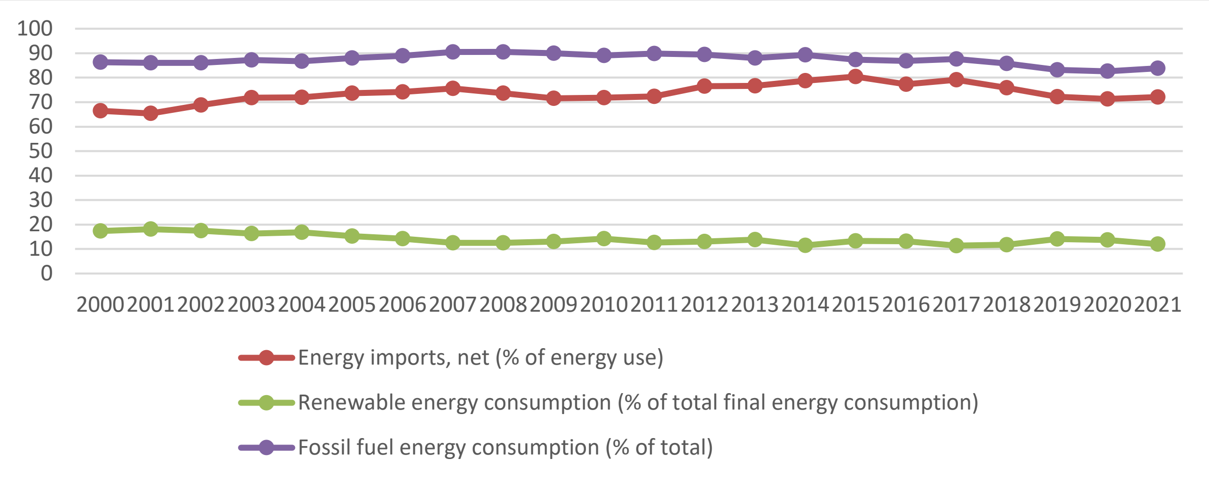
Figure 2: Total GHG Emissions (Mt CO_2e) in Turkiye between 2000 and 2023



Source: World Development Indicators (WDI), World Bank (WB)

When the energy usage of Turkiye examined between 2000 and 2021 in Figure 3, it is seen that the percentage of energy imports has increased. Furthermore, while the percentage of renewable energy consumption in total final energy consumption has decreased, fossil fuel energy consumption increased until 2008 and then began to decline. However, the rate of this decline is only 5% for all period. (WB, 2025)

Figure 3: Energy use in Turkiye between 2000 and 2021



Source: WDI (WB, 2025)

This study is structed as follows: Second section includes the literature review, the following section gives the information relating to indicators and the method used. In the fourth section, results and findings obtained from the analysis are presented, and the last section provides conclusion.

2. LITERATURE REVIEW

Previous studies conducted earlier in the literature indicated that some variables such as economic growth, energy use, FDI, renewable energy use, natural resource rents, openness to trade, population growth, globalization, urbanisation, and level of democracy are found to be significant factors affecting environmental sustainability. From this point, some studies about both Turkiye and method used are given below.

2.1. Studies on Climate Change and Energy Use

Bulut (2017) studied on impact of non-renewable and renewable energy on CO_2 emissions in Turkiye between 1970 and 2013. Findings shown that CO_2 emissions positively affects both non-renewable energy and renewable energy.

Bulut and Muratoğlu (2018) studied relationship between renewable energy consumption and gross domestic product (GDP) in Turkiye for the period 1990-2015. In this study, cointegration analysis and causality tests were employed and the findings indicated that renewable energy consumption and GDP were not related. Additionally, there was no finding regarding causality between GDP and renewable energy consumption in Turkiye.

Uzar and Eyüboğlu (2019) investigated relationship between income distribution and CO_2 emissions in Turkiye using Autoregressive Distributed Lag (ARDL) approach for the period 1984-2014. It was founded that income inequality and CO_2 emissions are positively related and also Environmental Kuznets Curve (EKC) hypothesis is valid. Accordingly, the results indicate that deterioration in income distribution will increase environmental degradation in Turkiye.

Haug and Ucal (2019) analyzed the impact of foreign direct investment (FDI) on CO_2 emissions using ARDL approach in Turkiye. They found that FDI has no impact on CO_2 in the long run. Also, CO_2 intensity is not affected by FDI, exports and imports whereas is affected by urbanisation. Moreover, this study showed the existence of EKC in Turkiye.

The Pollution Haven Hypothesis and the Pollution Halo Hypothesis are two significant hypotheses that explore how FDI affects environmental deterioration. According to the Pollution Haven Hypothesis (PHH), foreign direct investment (FDI) is utilized to move highly polluting sectors from wealthy countries to emerging countries with fewer restrictive environmental sustainability regulations. Thus, these emerging countries become havens for pollution. However, according to the Pollution Halo Hypothesis, industrialized countries use FDI to transfer their energy-saving, renewable energy-related, and pollution-reducing technology to host countries. Consequently, they are responsible for the decrease in environmental degradation (Duan and Jiyang, 2021). There are studies that test whether these hypotheses are valid for Turkiye.

Bulut (2021) investigated the drivers of ecological footprint (EF) in Turkiye using ARDL approach for the period 1970-2016. In this study, also both EKC hypohesis and pollution haven hypothesis (PHH) were tested. Findings indicated that renewable energy consumption negatively affects EF while industrialization does not affect EF. In addition, it has been seen that EKC hypohesis is valid, whereas PHH is not entirely valid in Turkiye. Apart from this study, other studies conducted have shown that the PHH hypothesis is found to be valid for Turkiye (Bulut et al. 2021; Mukiyen Avcı, 2023; Cil, 2023)

Gokmenoglu et al. (2021) studied relationship among energy use, military expenditure, economic growth, financial development and environmental degradation in Turkiye using fully modified ordinary least squares (FMOLS) approach between the years 1960 and 2014. Ecological footprint and CO_2 emissions were used as environmental degradation indicator. The findings showed that environmental degradation is positively affected by military expenditure, energy use and economic growth while negatively affected by financial development.

Yıldırım and Yıldırım (2021) determined the relationships among CO_2 emissions, GDP, energy use, financial development, trade opennes, and activities of construction sector in Turkiye using an ARDL approach for the period 1970-2015. The results show that construction sector activities, GDP, trade openness and energy use positively affect CO_2 emissions whereas financial development does not explain environmental degradation in the long run.

Habeşoğlu et al. (2022) determined the impact of oil price on the environmental degradation in Turkiye using bootstrap ARDL approach. According to the findings, government expenditures were positively related while taxation revenues were negatively related the environmental degradation in Turkiye. Also, low taxation rates on green energy investment and using the carbon tax policy were recommended to decrease environmental degradation in the study.

Özarslan-Doğan (2025) explored whether climate change performance affects environmental investments in Emerging Economies (E-7 countries) namely, Brazil China, India, Indonesia, Mexico Russia and Turkiye for the period 2008–2023 using the Parks-Kmenta estimator. In this study, renewable energy installed power capacity was used as dependent variable while climate change performance index score, GDP per capita, population growth and inflation were used as independent variables. Findings indicated that climate change performance index is positively related environmental investments, on the other hand population growth and inflation negatively related environmental investments, while GDP positively affects.

2.1. Studies on MCDM Methods

Ghenai et al. (2020) used Stepwise Weight Assessment Ratio Analysis (SWARA) and ARAS methods to rank renewable energy technologies using five sustainability indicators and they demonstrated the applicability of the methods.

Bilgili et al. (2022) studied on best renewable energy alternatives in Turkiye using Intuitionistic Fuzzy Technique for Order Preference by Similarity to Ideal Solution (IF-TOPSIS) method. Thus different alternatives for the renewable energy were ranked based on 5 main criteria and 25 sub-criteria. According to the results, among seven alternatives, solar energy has been found the best energy source. Wind and geotermal energy sources followed this source. Additionally, "capital/investment cost" was found as the most significant criteria among all.

Akusta and Cergibozan (2024), similar findings obtained. Different renewable energy sources were ranked based on fuzzy Analytic Herarchy Process (Fuzzy AHP). It was founded that solar energy is the best renewable energy source. It is followed by the wind and hydroelectric sources.

Dündar (2023) investigated optimal establishment location for construction of a compost facility using both k-means cluster analysis using ARAS method in Turkiye Three locations for compost facility were determined based on the analyses in this study.

Yücenur and Maden (2024) employed ARAS method for use of hydroponic greenhouses to select appropriate location on the basis on 21 indicators. Weights of the indicators were calculated Entropy method. Among 5 alternatives, Denizli province was found to be best location.

In another study conducted by Gelmez et al. (2025), environmental sustainability performance of the OECD Countries were measured using both ARAS and WASPAS method. According to the results, Sweden, Denmark and Finland are found to be countries that have highest performance scores.

Akmermer and Senturk (2025), analyzed the market regarding wood pellets trade using ARAS method. In this study performance scores were calculated for 17 countries based on indicators such as trade balance, logistic performance index, , CO_2 emission, concentration of supplying countries. Findings showed that United Kingdom, Japan, and the Netherlands are found to be leading countries in terms of exporting countries for wood pellets.

Doğruel (2025) explored the nexus between combating climate change and technological features. Also, position and rank of the countries on the basis of these features were determined. In addition to the multivariate statistical methods, TOPSIS method was used in this study. According to the findings, some relationships between variables were determined and also Nordic Countries were found to best performers in terms of environmental sustainability.

3. DATA AND METHODOLOGY

To provide an overview of Turkiye's performance regarding SDG7 and SDG13, **A**dditive **R**atio **As**sessment (ARAS) method applied to the years 2002, 2006, 2010, 2014, 2018 and 2022 and the results were compared. Thus, it was investigated whether there is an upward trend.

3.1. Determining Indicators

To measure performance of Turkiye in climate change and energy use, indicators employed were specified on the basis on SDG7 and SDG13 considering Global SDGs Framework (UN, 2023c) released by United Nations and they were obtained from World Development Indicators (WDI) database released by World Bank (WB, 2025). The indicator called “Access to electricity (% of population)” was not included in the analysis since it takes the value of 100 for all years.

In this study, 10 indicators were used in determining energy use and climate change performance of Turkiye. Regarding GHG emission indicator stated in SDG13, indicators representing carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) gases were used and other 7 indicators are related with energy use in Turkiye. In Table 1, the indicators, their abbreviations and related SDG are given below.

Table 1: Description of Indicators Used

Description of Indicators	SDG
Access to clean fuels and technologies for cooking (% of population)	SDG 7 Ensure accees to affordable, reliable, sustainable and modern energy for all
Energy intensity level of primary energy (MJ/$2017 PPP GDP)	
Energy imports, net (% of energy use)	
Renewable energy consumption (% of total final energy consumption)	
Fossil fuel energy consumption (% of total)	
Carbon dioxide (CO_2) emissions excluding LULUCF per capita (t CO_2e/capita)	SDG13 Take urgent action to combat climate change and its impacts
Nitrous oxide (N_2O) emissions (total) excluding LULUCF (Mt CO2e)	
Methane (CH_4) emissions (total) excluding LULUCF (Mt CO2e)	
Electricity production from renewable sources, excluding hydroelectric (% of total)	-
Electricity production from oil, gas and coal sources (% of total)	

3.2. Method Used

The method used in this study was proposed by Zavadskas and Turskis, 2010. It consists of 5 main succesive steps which are constructing decision matrix, normalisation of the decision matrix, obtaining weighted normalized matrix, calculating optimality function, determining utility degree.

Details of the steps are given below (Liu and Xu, 2021).

Step 1. Constructing decision-making matrix

$$X = \begin{bmatrix} x_{01} & x_{02} & \cdots & x_{0n} \\ x_{11} & x_{12} & \cdots & x_{1n} \\ \vdots & \vdots & \cdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \qquad \begin{matrix} i = 0,1,...,m \\ j = 1,2,...,n \end{matrix}$$

where,
m represents the number of alternatives.
n represents the number of criterion (indicators). One row is added to the matrix to include the optimal value of each criteria (indicator).
The optimal value can be determined using following equations;

$x_{0j} = \max x_{ij}$ (for benefit criteria)

$x_{0j} = \min x_{ij}^*$ (for cost criteria) where x_{ij} represents the value of the i alternative for criteria j while x_{0j} represents the optimal value of the criteria j.

Step 2. Normalisation of the decision matrix

$$\bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}}$$ if the criteria j is benefit criteria

$$x_{ij} = \frac{1}{x_{ij}^{*}}$$

$$\bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}}$$ if the criteria j is cost criteria

where $\bar{x}_{ij}$ is the normalized data and normalized decision-making matrix is given below

$$\bar{X} = \begin{bmatrix} \bar{x}_{01} & \bar{x}_{02} & \cdots & \bar{x}_{0n} \\ \bar{x}_{11} & \bar{x}_{12} & \cdots & \bar{x}_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ \bar{x}_{m1} & \bar{x}_{m2} & \cdots & \bar{x}_{mn} \end{bmatrix}$$

Step 3. Obtaning normalized weighed decision-making matrix

In the third step, a weight w_j is assigned for each criteria. Thus, the importance degree of the criterion is determined.

The weights satisfy that $\sum_{j=1}^{n} w_j = 1 \quad 0 \langle w_j \langle 1$

The normalized weighted value for each alternative in terms of each criteria is found by the following formula.

$$\hat{x}_{ij} = \bar{x}_{ij} * w_{ij}$$

$$\hat{X} = \begin{bmatrix} \hat{x}_{01} & \hat{x}_{02} & \cdots & \hat{x}_{0n} \\ \hat{x}_{11} & \hat{x}_{12} & \cdots & \hat{x}_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ \hat{x}_{m1} & \hat{x}_{m2} & \cdots & \hat{x}_{mn} \end{bmatrix} \qquad \begin{matrix} i = 0,1,\ldots,m \\ j = 1,2,\ldots,n \end{matrix}$$

Step 4. Calculating optimality function

The following formula can be used for finding the values of optimality function

$$S_i = \sum_{j=1}^{n} \hat{x}_{ij} \qquad i = 0,1,\ldots,m$$

The larger value of optimality function indicates that the alternative is the better.

Step 5. Determining utility degree

The utility degree for each alternative is calculated formula given below.

$$K_i = \frac{S_i}{S_0} \qquad i = 1,2,\ldots,m$$

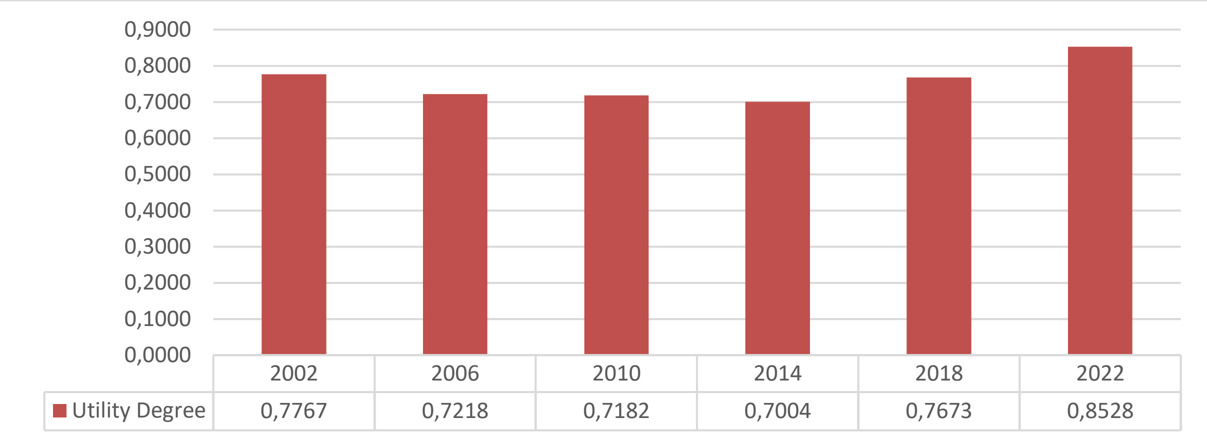
K_i lies in this interval $[0,1]$

Having implemented succesive steps, alternatives are ranked on the basis of their utility degrees. The alternative that has larger the utility value is regarded as the better alternative.

4. FINDINGS AND DISCUSSIONS

ARAS method was conducted for the years 2002, 2006, 2010, 2014, 2018 and 2022 respectively, and utility degrees obtained are given in Figure 3. When the method was applied, equal weight was assigned to the each indicator thus importance of the each indicator remained same over the years.

Figure 3: Utility Degrees Obtained from ARAS Method



Findings indicated that although Turkiye's performance regarding energy use and climate change remained largely flat until 2014, it began to improve after that year. However, Turkiye still ranks low in published indices related to environmental sustainability in the last decade.

According to the utility degrees obtained, it has been seen that there is no big differences between the utility degrees over the years. Utility degrees decreased from 0.7767 to 0.7004 between 2002 and 2014, after that time, increased and it reached 0.8528 in 2022. While between 2006 and 2014 utility degrees are at the almost same level, after 2014 it is seen that the utility degree has rised to 0.8528.

Especially, corrective actions have gained momentum after 2015 in Turkiye. The Paris Agreement, which encourages countries to jointly participate and cooperate in limiting global temperature increase to 1.5 degrees and reducing GHG emissions to zero by 2050, was signed by Turkiye on April 22, 2016, and was ratified on October 7, 2021. Moreover, Climate Law entered into force on July 2, 2025.

The impact of the Paris Agreement has been seen from energy policies. In addition to the current energy policies, increasing electricity production from renewable energy sources, making the necessary investments or the use of nuclear energy and also achieving net zero emission target by 2053 are included in the 12th development plan (Twelfth Development Plan, 2023).

5. CONCLUSION AND IMPLICATIONS

Climate change and global warming are the most important environmental threat for humanity. It is predicted that if the necessary measures are not taken, irreversible points will be reached after 2050. Therefore, it is crucial that countries determine their current situations and achieve the specified goals by 2030. Turkiye, which ranks among the top 20 countries in the world in terms of CO_2 emissions, has accelerated its efforts to combat climate change with the come into force of the Paris Agreement.

According to studies conducted earlier, existence of the PHH was validated in Turkiye. Therefore, to avoid negative impacts of the foreign direct investments, necessary regulations should be arranged as soon as possible. Also, Turkiye should continue to support investments and incentives to increase the use of renewable energy sources based on solar and wind power instead of fossil fuels to reduce CO_2 emission.

Turkiye imports most of the energy it uses, creating dependence on external sources for energy consumption. This situataion cause the increase in the current account deficit. By implementing energy efficiency policies and national climate strategies this dependence can be reduced.

Additionally, despite there have been positive developments regarding climate change policies in Turkiye, it is clear that numerous measures still need to be taken in this regard. Enacting the necessary laws or implementing regulations is of great importance. It should be considered that progress toward Goal 13 cannot be achieved unless the targets in Goal 7 are met.

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