# PUBLIC PERCEPTION AND ACCEPTANCE OF

# NUCLEAR ENERGY IN TURKEY: AN

# EMPIRICAL ANALYSIS BASED ON TWITTER

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**Abstract**

Public opinion is an important factor regarding success of nuclear energy policy implementation in a country, and existing literature focusing on determinants of public opinion emphasizes; trust in a variety of stakeholders, perceived risk and perceived benefits as the path leading to acceptability. However, until recently most of the studies were dependent on surveys or interviews. In order to fully grasp views of society in the matter, scholars must look into big data with help of social media. The novelty of this study lies in the quantitative analysis of Twitter data in Turkey, trying to explore public perception of nuclear energy by conducting a sentiment analysis. The findings support previous studies; a big portion of society has a negative state of mind with respect to nuclear energy. Future studies are encouraged with a larger, full archive dataset that are geolocated, with addition of network analysis in order to look closer at determinants of public opinion and detect social networks influencers for better collaboration with respective stakeholders.

## INTRODUCTION

### Nuclear energy in general

Technological advancements and growing global population have led to an increasing demand for energy [1]. However, the utilization of fossil fuels has become a pressing environmental concern due to its significant greenhouse gas emissions [2]. It has become imperative for governments to take measures in addressing this critical issue of the need for alternatives that are both sustainable and environment friendly. Nuclear power plants have been advocated as an alternative energy producing method by scientists for quite some time as it has one of lowest carbon footprint among options [3].

Nonetheless, nuclear energy has been a controversial issue in many countries from day one [4][5], risks associated with nuclear energy and power plants, such as disastrous accidents or radioactive waste management, raising serious opposition [6]. Memorable nuclear power plant accidents in the history can chronologically be listed as the Three Mile and the SL-1 accident (1961), Island accident (1979), the Chernobyl disaster (1986) and the Fukushima nuclear disaster (2011). Most recently, the alleged attack of the Zaporizhzhia nuclear power plant on March 5, 2022 in Ukraine stirred public view.

Numerous studies have focused on public attitudes, examining determinants of those attitudes based on various methodologies like traditional surveys and focus group interviews and more recently big data analysis via social media data. The reason behind such focus is, in addition to technological and economic aspects there also social burdens of nuclear energy facilities that are crucial for effective implementations. If the public opinion is so widely and strictly negative that opposition becomes resistance, it could lead to delay in plans with unavoidable economic results or alternatively governments could simply choose to act on public opinion as we have seen in Germany case of phase out after Fukushima accident and public resistance.

Costa-Font et al. elaborate in their study whether opposition regarding nuclear energy is a result of blind political support or individual decision and, if it is the latter how does knowledge about nuclear waste management influence people’s attitudes? They reach the conclusion that due to lack of knowledge and political anchors, when thinking about risks, individuals tend to rely on their political affiliation, additionally individuals feeling more informed about radioactive waste are more likely to support nuclear power. [7]

De Groot et al. find that higher risk perceptions of nuclear power result in a decrease in its acceptability, also social networks influence acceptability indirectly, through its direct effects on risk & benefit perceptions. [8]

“Not in my backyard” (NIMBY) phenomenon has been another aspect that has been subject to scholar study. It basically states that proximity of residence to nuclear power plant will reduce support due to increased perceived risks [9]. However more recent empirical study does not support NIMBY phenomenon, controversially, Uji et al. find support for reverse-NIMBY, as long as governments are ready to handle oppositions with knowledge and emphasize job security and help benefits of a nuclear power plant in a local area [10].

Gong et al. applies newer methods by exploring Sina Weibo, a social media platform in China, with respect to nuclear energy posts between 2015-2019, and finds a high volume of interaction. Geolocation tagging leads to the conclusion that high proximity causes higher attention with more posts and discussions on the platform. Network analysis shows individual user accounts that post short scientific videos draw heated discussions even more than NGOs. [11]

Vechgama et al. conducts sentiment analysis in Thailand using Facebook comments between 2009-2022 about nuclear energy and finds that since %80 remain neutral, the government has a big opportunity to change their attitudes towards positive with the right policies. [12]

### Nuclear energy in Turkey

Turkey, with a population of 85.279.553 as of as of December 31, 2022, set a target of net zero emission by 2053 upon ratifying the Paris Agreement 2011. Subsequently Turkey National Energy Plan was developed in 2022 to be carried out in order to reach this target. According to this plan, which consists of 5-year periods projections, primary energy consumption, which was 147.2 Mtoe in 2020, is expected to increase to 205.3 Mtoe by 2035. More importantly, 5.9% of this projected consumption is forecasted to be supplied by nuclear energy. [13]

Currently, there is a nuclear power plant in Mersin, anticipated to commence energy production in 2024. Additionally, there are plans underway for the construction of two more nuclear power plants in Sinop and İğneada.

However, nuclear energy and its possible consequences has been a point of focus for the Turkish government and public way before. On August 12, 1986, a few months after Chernobyl Nuclear Power Plant accident, Cahit Aral, the Minister of Industry and Trade, organized a press conference in Rize. The aim was to put unease of people living in the Black Sea Region due high levels of radiation and its possible impacts on tea crops, to rest. The Minister emphasized there was nothing to fear, people could go on to live their lives as usual, he even demonstrated his point by drinking a hot cup of tea in front of the press. [14]

We cannot say whether this attempt was successful but today Turkish Energy, Nuclear and Mineral Research Agency (TENMAK) is aware of the social burdens mentioned above so much so that they acknowledge negative attitude of public regarding nuclear technologies as a threat for both SWOT and PESTLE analysis in the 2022-2026 Strategic Plan. Nevertheless, in the same Strategic Plan of TENMAK, public or local communities are not listed among stakeholders [15]. On the other hand, OECD Nuclear Energy Forum on Stakeholder Confidence Radioactive Waste Management defines stakeholder as “*any actor – institution, group or individual – with an interest or a role to play in the radioactive waste management process”* and accepts potential host communities among stakeholders [16].

In the light of current and potential nuclear energy activity in Turkey, public opinion drew scholarly interest. Ertör et. Al. explore determinants of preferences for nuclear energy and find “knowledge of climate crises” is a factor of nuclear support. [17]

In his study analysing survey findings, Özcan shows that a big majority is against nuclear power plants, then goes onto recommend full stop policy as a response to public opinion.[18]

After a comprehensive survey, Ediger et. al. state in their study people favour the installation of renewable and natural gas plants over coal and nuclear plants. At the same time, public understanding about energy issues is low. [19]. When they repeat the survey in December 2021, the support for installation of nuclear power plant seem higher, opposition becomes strong when border of the city where respondents lived in was chosen as installation site. This finding seems to support “Not in my backyard” doctrine (NIMBY) also emphasized above. [20].

The aim of this study to give a picture of perception of nuclear energy and technologies in Turkey as a reference point for future study to move on to the reasons behind, such as trust, risk management & engagement and its novelty lies in using social media data for gathering in-depth understanding.

1. METHODS

There were 62.55 million social media users in Turkey in January 2023. Twitter’s own ad planning tools state that Twitter’s potential ad reach in Turkey increased by 2.5 million (+15.2 percent) between the start of 2022 and early 2023 [21]. Believing that social media data provides more in-depth view of public opinion with the analyses possible, Twitter was used as a source of data for the method shown in Fig 1 below.

FIG. 1. Research Method

1. **Data collection**

Since there could not be found a ready dataset on the subject of the paper, the data were collected by using Twitter API and web scraping via tweepy, a free library provided by python. Currently, Twitter offers three types of membership for developers and researchers to obtain tweet data and metadata: free, basic, enterprise. Due to research budget, the author had basic level access which meant collecting a maximum of 10.000 tweets from the last seven days per month. Keywords were determined to stay within the framework as: “#akkuyu nükleer , #nükleer enerji , nükleer santral , nükleer güç , #nuclearenergy”.Turkish was chosen as language and retweets were excluded. The collected tweets were stored in a dataframe with a csv format file where user ids and texts could be seen on respective columns as shown in Table 1.

TABLE 1. SAMPLE OF COLLECTED TWEETS IN DATAFRAME

|  |  |
| --- | --- |
| id | text |
| 1693984649251545484 | Yeri SIKINTILI olan şu NÜKLEER SANTRAL ne olacak… |
| 1692432822860927071 | bütün gelişmiş ülkelerde nükleer santral … |

1. **Data pre-processing**

In order to get rid of the parts of the data irrelevant for sentiment analysis first duplicate tweets were removed; then tokenization, normalization, lemmatization steps were applied; finally stopwords and rare words were removed using two natural language programming libraries provided in python: zemberek and nltk python. After the pre-processing, the sample size was 267 texts from 267 separate users.

1. **Sentiment analysis**

There is a variety of sentiment analysis methods and tools, BERT multilingual was chosen for the paper among those. BERT multilingual is a pretrained model with 102 languages from Wikipedia, it predicts the sentiment of a text with an integer score from 1 (negative) to 5 (positive). The output of analysis dataframe with a csv format file where sentiment scores could be seen with corresponding user ids and texts as shown in table 2.

TABLE 2. SAMPLE OF PRE-PROCESSED TWEETS IN DATAFRAME

|  |  |  |
| --- | --- | --- |
| id | text | sentiment |
| 1693984649251545484 | Yeri SIKINTILI olan şu NÜKLEER SANTRAL ne olacak.. | 1 |
| 1692432822860927071 | bütün gelişmiş ülkelerde nükleer santral … | 5 |

## RESULTS

The result of analysis was visualized using another python library: matplotlib. In the cleaned dataset, %90,1 of users had a negative attitude, %5.0 had positive and %2.7 had very positive attitude towards nuclear energy while %2.3 seemed to remain neutral. Overall, the finding support previous studies.

FIG. 2. Chart showing the result of sentiment analysis in proportions

## LIMITATIONS AND FURTHER RESEARCH

There are limitations regarding the results and their interpretation. First of all, Twitter API policy change in June 2023 meant free access to data was restricted even for academic research purposes. Due to budget the author had basic level access. This resulted in a limited time frame for tweet search: only tweets from past seven days could be accessed rather than full archive. In the face of this limitation, temporal analysis and clustering through time could not be done. Secondly, basic level access did not allow tagging tweets with geolocation. A sentiment analysis with geolocated texts could help explore NIMBY phenomenon. Thirdly, basic level access only allowed 10.000 tweets per month. A bigger sample size with full access would be more representative. Fourthly, it was not possible to obtain user interaction data like followers or followings. Finally, twitter users could be consisting of mostly younger generations, thus may be controlled for being representative.

Further study with full level access with these attributions could help answer the following research questions: What are the magnitudes of public attention to nuclear power between 2017-2023? Are there differences for different stages? Are there any differences in the level of public attention to nuclear power across Turkey? (Mersin, Sinop and Tekirdağ in particular) Are there any influencers (leaders) in the nuclear power topic network? How have these influential players changed?Are there any differences in perception among subscribers due to being exposed to nuclear energy experts and climate change NGOs? Are there any differences in perception among subscribers due to political anchoring?

## CONCLUSION

The findings of the paper indicate there is still a big opposition of public in Turkey regarding nuclear energy. Current strategic plans and policies show that the government bodies and respective institutions are aware of these negative attitudes, however, still lack an active and effective action planning to turn the attitude into positive. Further research with bigger dataset and elevated access to Twitter data could help organize an action plan to increase public acceptability of nuclear energy through collaborations with various stakeholder.

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