



5th Intercontinental Geoinformation Days

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The role of geomatics engineering discipline on nearly zero energy building concept for Türkiye

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Keywords

Energy Efficiency
CO₂ Footprint
nZEB
BIM

Abstract

In order to cope with the climate crisis and achieve the carbon neutrality target for the year of 2030 and the year of 2050, the factors that cause carbon footprint should be investigated, and required actions to reduce the effects of greenhouse gases should be determined. It is a fact that the building sector causes about 40% of carbon dioxide emissions from energy consumption, especially in European countries. In this context, several actions on energy efficiency for buildings have been applied in the European Union (EU) in the last two decades. In parallel with EU policies on energy efficiency for buildings, some legal regulations have also been enacted, and some strategic action plans have been introduced in Türkiye. These efforts should be carried out based on the land management paradigm. Accurate, up-to-date, and well-organized location-based data is required to achieve the aims of related legal regulations and action plans. This study aims to reveal the main study areas to be carried out by the Geomatics Engineering discipline to reduce the carbon footprint and to reach the carbon-neutral target by planning carbon sink areas.

1. Introduction

According to NASA, global warming has been caused by increasing the levels of heat-trapping greenhouse gases in the Earth's atmosphere due to human activities and the burning of fossil fuels (URL 1). One of the significant reasons for global warming is the amount of carbon dioxide (CO₂) emitted into the atmosphere. The increasing use of fossil fuels due to population growth in the world stimulates the amount of carbon dioxide, the most abundant primary greenhouse gas in the atmosphere. The most significant negative impact of greenhouse gas emissions is climate change. Instead of using fossil fuels, alternative renewable energy sources that do not emit carbon dioxide, such as biofuels, wind, solar, geothermal, nuclear, and hydraulic energy, should be used to eliminate the damages of global warming (Güllü & Bayraç, 2017).

Unlike fossil fuels, renewable energy sources can be considered as sustainable and clean energy sources. In accordance with Law No. 6094 on Electricity Energy of Renewable Energy Sources published in 2010, Renewable Energy Sources (RES) are defined as non-

fossil energy such as hydraulic, wind, solar, geothermal, biomass, gas derived from biomass (including landfill gas), wave, current energy and tidal energy (URL 2).

Climate change has become an important issue that is urgently required to deal for all countries. Türkiye is one of the countries with a primary risk of being affected by climate change due to its geographical location, climate regime, industrial development, and density population on the coast sides (Bozoğlu, 2018). According to the United Nations Environment Program (UNEP), Türkiye, which accounts for 1.17% of global emissions, is one of the countries producing the most greenhouse gases (URL 3). According to the results of the greenhouse gas inventory in Türkiye, the total greenhouse gas emission in 2020 increased by 3.1% compared to the previous year. It was calculated as 523.9 million tons (Mt) CO₂ equivalent (eq.). CO₂ eq. in total greenhouse gas emissions in 2020. Energy-related emissions have the largest share at 70.2%, followed by agriculture at 14%, industrial processes and product use at 12.7%, and the waste sector at 3.1% (TUIK, 2022). Figure 1 shows the ratios of greenhouse gas emissions by sectors:

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Cite this study

Kartal B, Alkan R M & İşiler M (2022). The Role of Geomatics Engineering Discipline on Nearly Zero Energy Building Concept for Türkiye. 5th Intercontinental Geoinformation Days (IGD), 45-47, Netra, India

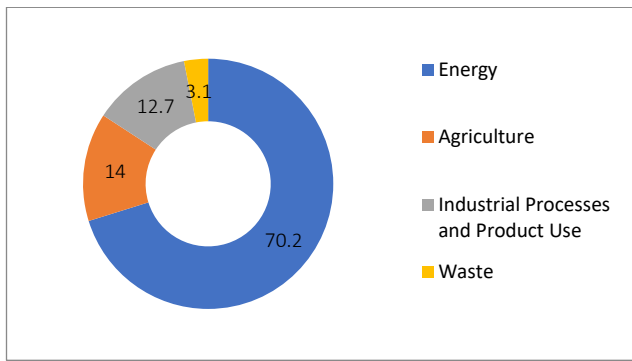


Figure 1. Ratios of greenhouse gas emissions by sectors (TUIK,2022)

According to the Regulatory Indicators for Sustainable Energy (RISE) report published by the World Bank in 2019, Türkiye ranked 69th out of 111 countries in the "World Sustainable Energy" ranking with a total of 82 points, scoring 80 points in renewable energy, 100 points in energy access and 66 points in energy efficiency. In the renewable energy category, it ranked 28th worldwide with 71 points (URL 4).

Although our country has become a party of international conventions later because of its various drawbacks on some climate change steps, it has continued to carry out its own national studies about decreasing greenhouse gas emissions (Ecer et al., 2021). The national legal frame is given in Table 1.

Table1. The National Legal Frame

Release Date	Legal Documents
2007	Energy Efficiency Law
2008	Building Energy Performance Regulation
2010	National Climate Change Strategical Document (2010-2023)
2010	Climate Change Action Plan (2011-2023)
2010	Tenth Development Plan (2014-2018)
2013	ENR Strategic Plan (2015-2019)
2014	National Energy Efficiency Action Plan (2017-2023)
2018	ENR Strategic Plan (2019-2023)
2019	Eleventh Development Plan (2019-2023)
2019	Regulation on the Amendment of Energy Performance in Buildings Regulation
2022	

The European Green Deal, announced by the European Union in 2019 and adopted by Türkiye in 2021, aims to reduce carbon emissions by fifty percent by 2030 and to be carbon neutral by 2050. This agreement has set targets for climate neutrality and a greener and more sustainable world.

In 2021, Türkiye became a party to the Paris Agreement, the first legally binding international agreement on climate change. The agreement's purpose is for each country party to contribute to global climate activities in line with their means and to report their national contribution declarations every five years. Another goal of the 2030 agreement is to keep global warming below 2°C at the international level by reducing greenhouse gas emissions that cause global warming to pre-industrial levels (URL 5). In addition to energy efficiency and renewable energy activities in our

country, Türkiye has declared that its activities in this direction will continue and that it is open to joint initiatives in this field with the acceptance of the Paris Agreement (İsiler et al., 2022).

In this context, one of the essential studies in the "Regulation on the Amendment of the Regulation on Energy Performance in Buildings" is the obligation to design buildings as nZEB (Nearly Zero Energy Building) by 2025, that is, to meet 5% of its primary energy needs from renewable energy sources.

Electricity, water, and natural gas consumption in residential buildings directly cause carbon emissions. Buildings have the largest share in final energy consumption, with approximately 34% in Türkiye and 40% worldwide. This situation reveals the importance of energy efficiency studies for buildings (Ministry of Environment, Urbanization and Climate Change, 2020).

2. The Role of Geomatics Engineering Discipline in the Realization of Türkiye's Alternative/Clean Energy Policies

According to the International Federation of Surveyors (FIG), Geomatics Engineers have a wide range of skills and tools that can be used to adapt to and mitigate climate change (FIG, 2014). Some of the studies that the Geomatics Engineering discipline can do to prevent the climate crisis are as follows:

- GIS-based tracking of the carbon footprint as a time series
- Determining the solar energy potential of the roofs of existing buildings by establishing a Building Information System
- Creating 3D Models of the building stock using Unmanned Aerial Vehicles (UAV) or LIDAR systems.
- Energy analysis of new buildings and existing buildings whose digital twins are created with the help of UAV or LIDAR systems through Building Information Management.
- Monitoring the amount of energy produced and consumed by nZEB buildings.
- Determining the carbon tax criteria for nZEB buildings that cannot produce their energy share.
- Integration of consumed energy amount for independent sections in the nZEB buildings into the real estate evaluation process (Doldur, 2022).
- Studies about resident density analysis, estimating shadows created by urban features, etc.
- Creation of surface temperature maps using satellite images for preliminary studies on geothermal energy field research and access to clean energy (Cambazoğlu et al., 2015).
- Geographical Information System (GIS) to determine the most suitable location for a wind power plant (Aitzhanov, 2016) and to utilize wind energy.
- Evaluation of location criteria for nuclear power plants with GIS (Başkurt and Aydın, 2020).
- Preparation of emergency action plans in case of a leakage in a nuclear power plant and determination of the regions to be affected according to the hazard level.

- Establishment of 3D City Models Management Information System and monitoring and querying building stock updates.

3. Conclusion

This study reveals the importance of energy efficiency nationally and internationally. In this sense, it is seen that the Geomatics Engineering discipline can take part in a wide variety of fields of study in line with carbon-neutral targets. This discipline plays a very crucial role in energy efficiency since they are professionals who ensure the collection, storage, processing, analysis, querying, and visualization of spatial data. Decision makers and end users can access up-to-date, reliable, location-based energy data with sufficient accuracy with the contributions of the Geomatics Engineering discipline. In this context, it is seen that a new subject of study has emerged for our profession.

Acknowledgment

This study was carried out as part of the PhD Thesis prepared by Büşra KARTAL at Istanbul Technical University, Graduate School.

References

- Aitzhanov C. (2016), "Site Selection Technique for Wind Turbine Power Plants Utilizing Geographical Information Systems (Gis) and Analytical Hierarchy Process (AHP)", M.Sc. THESIS Chingis Department of Civil Engineering Construction Management Program Thesis, May 2016, Istanbul.
- Başkurt, Z. & Aydın, C. C. (2020). Nükleer Santraller için Yer Belirleme Kriterlerinin Coğrafi Bilgi Sistemleri ile Değerlendirilmesi. *Türkiye Coğrafi Bilgi Sistemleri Dergisi*, 2 (1), 37-48. Retrieved from <https://dergipark.org.tr/en/pub/tucbis/issue/52936/655064>.
- Bozoğlu B. (2018), "Paris İklim Anlaşması Kapsamında Türkiye'nin Erken Uyarı Sistemine Dair Yapması Gerekenler", Ankara Üniversitesi Sosyal Bilimler Enstitüsü, Doktora Tezi, Ankara.
- Cambazoğlu S., Yal G. P., Eker A. M., Koçkar M. K., Şen O., and Akgün H., "Jeotermal Arama Çalışmaları Kapsamında ASTER Uydu Görüntüleri ile Yüze Sıcaklığı Haritalaması ve Jeotermal Anomalilerinin Araştırılması," 68. Türkiye Jeoloji Kurultayı Bildiri Özleri Kitabı (6-10 Nisan 2015), Ankara, Türkiye, 2015,
- Ministry of Environment, Urbanization and Climate Change (2020), "Guide to Energy Efficient Renovation of Public Buildings", October 2020, Ankara.
- Doldur M. (2022), "Enerji Verimliliği Odaklı Yapı Yönlendirmesi İçin BİM Tabanlı Bir Model Önerisi: Kentsel Dönüşüm Örneği", Yüksek Lisans Tezi, İstanbul.
- Ecer K., Güner O., Çetin M. (2021), "Avrupa Yeşil Mutabakatı Ve Türkiye Ekonomisinin Uyum Politikaları", *İşletme Ve İktisat Çalışmaları Dergisi*, Yıl: 2021, Cilt: 9, Sayı: 2, S. 125-144.
- FIG (2014), "The Surveyor's Role in Monitoring, Mitigating, and Adapting to Climate Change".
- Güllü M. ve Bayraç H.N. (2017), "Biyoyakıt Üretimi, Karbon Emisyonu ve Ekonomik Büyüme İlişkisi: Amerika, Brezilya Ve Almanya Örnekleri", *Akademik Bakış Dergisi* Sayı: 64, Uluslararası Hakemli Sosyal Bilimler E-Dergisi.
- İşiler, M., Yanalak, M. & Selbesoğlu, M. O. (2022). Arazi Yönetimi Paradigması Çerçevesinde Türkiye'de Binalar İçin Enerji Kimlik Belgesi Uygulamasının Değerlendirilmesi. *Niğde Ömer Halisdemir Üniversitesi Mühendislik Bilimleri Dergisi*, 11 (3), 689-705. DOI: 10.28948/ngumuh.1054333
- TUİK 2022, Sera Gazı – Emisyon Gazı İstatistikleri: <https://data.tuik.gov.tr/Bulten/Index?p=Sera-Gazi-Emisyon-Istatistikleri-1990-2020-45862>.
- URL1: <https://climate.nasa.gov/resources/global-warming-vs-climate-change/#:~:text=Global%20warming%20is%20the%20long,gas%20levels%20in%20Earth's%20atmosphere>. Last accessed: November 30, 2022.
- URL2: <https://www.resmigazete.gov.tr/eskiler/2011/01/20110108-3.htm> Last accessed: November 30, 2022
- URL3: https://www.unep.org/explore-topics/climate-action/what-we-do/climate-action-note/state-of-climate.html?gclid=CjwKCAjwwL6aBhBlEiwADycBIAASOXCnGqzQY4Jf9eyEqImRovGGITjsrVhOGPWHS9rQ1-mPVfe8CRoCp4cQAvD_BwE. Last accessed: November 30, 2022
- URL4: https://rise.esmap.org/data/files/reports/rise_2020_country_profiles.pdf. Last accessed: November 30, 2022
- URL5: <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement> November 30, 2022.