

ENVIRONMENTAL CONFLICTS IN TIMIȘOARA. CASE STUDY: GAS STATIONS

Raluca VĂDUVA

*Department of Geography, Faculty of Chemistry, Biology, Geography, West University of Timișoara, Romania
Corresponding author: raluca.vaduva@e-uvt.ro*

Abstract: The increase in the number of motor vehicles has led to a significant demand for fuel consumption, which has led to a need for more gas stations in urban areas. However, operating a gas station requires obtaining various permits, as they have the potential to negatively affect the natural or built environment or individuals residing or working nearby. Additionally, specific regulations must be followed when selecting a location to construct a gas station, including maintaining minimum distances from certain surrounding functional buildings. Gas stations in urban areas are often a source of environmental conflicts due to their flammable and explosive nature and the handling of hazardous substances on-site, mainly as they are usually situated close to residential, commercial, or office areas. To identify environmental conflicts related to gas stations and residential areas, a study was conducted on sixty operational and non-operational gas stations in the Timișoara area in 2023, most of them being located on the primary access routes into the city. The study revealed that 9.62% of the total gas stations in use did not comply with the minimum distance requirements from nearby urban functions as mandated by law. This non-compliance poses a potential risk to individuals residing or working near the gas station. Furthermore, a survey was conducted to identify the perceptions and attitudes of Timișoara inhabitants towards the acceptability of gas stations. A total of 141 questionnaires were completed to determine the awareness of the existence of a potentially conflicting association.

Keywords: environmental conflict, potentially conflicting associations, gas station, urban area, residential use

1. INTRODUCTION

The impact of human activities on the environment is a topic of increasing concern. Specific environmental issues can reach the conflict stage. Environmental conflicts can arise when one stakeholder expresses concern about non-compliance with the environmental policies of another stakeholder's plan, project, or activity and opposes it through various actions (Torre et al., 2014). Environmental conflicts can take many forms, such as land-use conflicts, locational conflicts, or conflicts of urban functional space (Ioja et al., 2015). In cities, potentially conflicting associations have become more complex due to the pressure on land, the complexity of urban functions, and the increasing number of interests that need to be considered (economic, social, and environmental). Environmental conflicts can be deep-rooted in certain areas with functions considered in conflict, mainly residential functions in conflict with

industrial, commercial, or service functions.

Gas stations, also known as petrol or fuel stations, are facilities that include fuel dispensing equipment, storage tanks, and ancillary buildings (Nieminen, 2005). Gas stations are emerging with urban sprawl and the development of cities, with the implied increase in the number of vehicles and growing fuel demands (Afolabi et al., 2011; Ajman et al., 2021). In some cases, rapid urban sprawl has also led to the inclusion of gas stations in residential areas (Ioja & Tudor, 2012). While gas stations are important for residents to refuel their vehicles, they also represent an environmental conflict due to the associated risks such as fires, explosions, and pollution. Therefore, paying particular attention to selecting the proper location for these facilities is crucial. According to Pîndaru et al., (2021), gas stations operating in residential or built-up areas must abide by regulations that govern industrial activities. Gas stations are more than just places to refuel vehicles because of the complexity of the activities carried out on-site

(Giovannoni, 2016). Additionally, they are considered public spaces due to the related services, such as coffee shops, restaurants, and other public food premises, as highlighted by Giovannoni (2016). Apart from the quality of fuel, its price, and the brand under which it is sold, the complexity of services offered by a gas station also influences its attractiveness to customers.

1.1. Site selection - a critical step in any business project

The process of selecting a site for constructing a gas station is a crucial step for successfully establishing such a business (Khahro et al., 2014). When choosing the location, multiple criteria should be considered, such as the traffic conditions in the nearby areas, the number of other gas stations in the vicinity, and the characteristics of the surrounding areas (Semih & Seyhan, 2011). Additionally, there are significant legal requirements that the business must comply with. Since gas stations pose a potential risk to both humans and the environment, the safety of the people should also be considered while planning the development (Adewuyi, 2020). The interests and perceptions of the most affected stakeholders, including the project proponent and the residents living in the vicinity, should also be considered. This is important from an economic standpoint, as well as from a social and environmental perspective.

Gas stations are commercial establishments that can cause environmental problems, particularly if they do not follow legal regulations (Iojă et al., 2015). When environmental conflicts arise, they can directly impact the safety and security of individuals or communities, the integrity of ecosystems, and the economic or cultural viability of a region (Dukes, 2004). Inadequate regulations or insufficient enforcement of existing ones can create major issues with the natural and built environment (Batambock et al., 2021; Amoako et al., 2022).

Currently, there is no standardised method for conducting an environmental risk assessment of gas stations in the EU. Each Member State has its own set of guidelines to follow (Mäkkä et al., 2021). In Romania, gas stations must comply with all the legal requirements and technical regulations in force, including minimum requirements for the health and safety of people and property (as outlined in Order 174/2005) as well as environmental protection measures such as waste management, wastewater, noise pollution, air pollution, soil pollution, etc. Furthermore, an environmental impact assessment (EIA) study is mandatory at the project stage. The EIA study collects and documents information,

giving expert opinions on the related environmental consequences (Khahro et al., 2014).

As per Order 174/2005, which approves the technical regulations for the design, execution, operation, decommissioning, and post-use of a gas station, the location of such a facility should adhere to specific safety standards. These standards include maintaining minimum safety distances between equipment and technologies that have a fire or explosion hazard and those that have a high vulnerability exposure, such as high-voltage power lines, sport and leisure facilities, constructions with technological processes, or warehouses of exceptional or particular importance, blocks of flats, private or public buildings with a large influx of people. Gas stations that have liquefied petroleum gas (LPG) filling stations must follow specific rules for the design, execution, and operation of natural gas supply systems (Standard NP 037-99), as related incidents can cause severe damage to both people and buildings. In Romania, Order 119/2014 specifies that any new gas station must be located at least 15 m from the windows of residential buildings, whether individual houses or blocks of flats. This distance is measured from the facility's perimeter to the dwelling's facade. This is because gas stations can generate discomfort or health risks for the nearby population due to the nature of their activities. By complying with the minimum distances required by law, a company can take precautionary measures that can reduce the negative consequences of a potentially hazardous event.

1.2. Gas stations - a potentially conflicting association

Incidents of fires and explosions have been reported in gas stations worldwide and have been studied in depth by experts (Fowler & Baxter, 2000; Mutungi et al., 2019). The media has also reported on such incidents. In countries like Ghana, Lagos, Nigeria, and South Africa, there have been several gas station fires and explosions resulting in numerous human casualties due to ineffective land use planning and development (Taylor et al., 2016). The gas station fires in poorly planned urban areas in Ghana have raised questions about the effectiveness of zoning and land use planning regulations following a gas station fire that claimed around 150 deaths (Hemming, 2020). A similar event occurred in Jamaica, with numerous injuries and seven deaths recorded (Hamid et al., 2009). Given that gas stations store significant amounts of fuel, including gasoline and diesel, which require maximum safety, Liu et al., (2020) proposed a regional assessment model for fire emergency facility

requirements in Changsha, Hunan Province (China). It is interesting to note that using mobile phones in gas stations is prohibited, as it can generate the so-called phantom fire risk, a phenomenon mentioned in the UK when oil companies established restrictions on using mobile devices at gas station sites (Burgess, 2007).

Gas stations can contribute to air pollution and negatively affect people's health. Pollution can occur due to normal gas station operations, including releasing volatile organic compounds (VOCs), accidental spills or improper station functioning (Iojă & Tudor, 2012). According to Mäkkä et al., (2021), VOCs from gas stations are not considered a significant source of risk. However, traffic is regarded as the primary source of VOCs in urban areas, followed by gas stations and industrial spaces that use products containing VOCs (Mäkkä et al., 2021). Along with hydrocarbons, traffic also emits CO₂, NO_x, and particulate matter, as Karakitsios et al., (2007) noted.

Studies have shown that the concentration of volatile organic compounds (VOCs) near gas stations is influenced by the station and the number of vehicles refuelling or traffic in the area (Morales Terrés et al., 2010). The higher the traffic, the more pollutants are emitted. Benzene, toluene, ethylbenzene, and xylene (known as BTEX) are the primary pollutants that can affect the health of people who work in gas stations, live nearby, or participate in activities in the area, especially children in educational institutions (Correa et al., 2012; Harrison et al., 1999; Karakitsios et al., 2007; Masih et al., 2016). Such exposure can increase the risk of childhood cancer and adverse health effects due to the increase in ambient benzene concentrations.

Gas station workers are also at risk of developing cancer due to prolonged exposure to VOCs. Studies have been conducted in different parts of the world, including the West Midlands in the UK and Kolkata in India, which highlight the risks associated with gas stations and the need to mitigate these risks to protect the health of people who live and work in their vicinity (Harrison et al., 1999; Karakitsios et al., 2007; Majumdar (né Som) et al., 2008). Kitwattanavong et al., (2013) also mentioned the same situation in their study of gas stations in downtown Bangkok. Morales Terrés et al., (2010) highlighted that proper land management requires a buffer zone around gas stations to protect the vulnerable population and activities in schools, hospitals, and community centres. The technical requirements for limiting VOC emissions from the storage, loading, unloading, and distribution of gasoline at terminals and fuel distribution stations are measured in Romania using internationally

recognized standards, namely SR EN ISO 16017-1, SR EN ISO 16017-2, and SR EN 13649 (GD 568/2001, as amended and updated).

Concerns have been raised regarding the impact of gas stations on population health. Weng et al., (2008) and Chang et al., (2009) suggest that the density of gas stations in Taiwan may indicate the occurrence of childhood leukaemia and lung cancer in women, respectively, while Chiu et al., (2011) highlight a link between gastric cancer and gas stations. Sairat et al., (2015) created isoconcentration maps in Thailand to demonstrate the benzene concentrations at two gas stations. Another issue related to gas stations is their impact on housing sale prices in multifamily neighbourhoods. Zhao et al., (2017) found that housing prices in Xuancheng, China, increase significantly with each additional kilometre from the gas station. In addition to these hazards, gas stations may even contribute to crime in certain socio-demographic conditions of specific neighbourhoods (Bowers, 2014; Groff & Lockwood, 2014; Zahnnow, 2018).

In Romania, studies related to environmental conflicts and gas stations are singular, all referring only to Bucharest, the capital of Romania. For example, Iojă & Tudor (2012) analyse the distances between residential areas and gas stations in the suburban area of Bucharest; Onose et al., (2015) assess the location of gas stations from the perspective of environmental conflicts in Bucharest, and Pîndaru et al., (2021) provide information on the area, and accessibility of gas stations about the presence of vegetation as a mitigating factor of the adverse effects of gas stations.

Therefore, the present study aims to (i) identify whether gas station minimum distances from residential or other buildings are respected and (ii) identify whether gas stations represent a hazard to citizens' lives and can be considered an environmental conflict.

1.3. Study area

As per the National Institute of Statistics, Timișoara is one of the most populated cities in Romania, with a population of 250,849. Apart from the registered population, there are also unregistered inhabitants in the city who do not have a permanent residence in Timișoara. In recent years, the number of Timișoara's residents has decreased. In contrast, the number of peri-urban residents has increased, especially in the communes of Giroc, Dumbrăvița, Moșnita Nouă, and Ghiroda, as per the National Institute of Statistics report of 2023. The increase in peri-urban residents is due to the improved quality of

life, which encourages high- and middle-income citizens to relocate to such areas. A significant part of the working population in the nearby localities works in Timișoara, which results in a substantial influx of people from the peri-urban area to the city and vice versa during the day.

As the city expands, it becomes increasingly important to provide residents with access to transportation to reach their desired destinations. However, urbanization often leads to an increase in population density and concentration of citizens in certain areas. This has resulted in urban sprawl, which has increased the number of vehicles on the road and led to a higher demand for fuel, consequently leading to more fuel distribution stations. In 2022, the General Directorate of Driving Licenses and Registrations reported that there were over 148,000 registered cars in Timișoara (as shown in Figure 1), an increase of almost 50% compared to the number of cars in 2010. This number does not include vehicles registered in other localities of Timiș County or other categories of motor vehicles such as motorcycles, buses, and vans. Figure 1 also shows the evolution of the number of cars registered in Timișoara and neighbouring localities from 2010 to 2022.

The city's vehicle fleet constantly increases, so residents need gas stations. Despite the noticeable rise in the number of charging stations for electric or hybrid vehicles in recent years, fossil-fuel vehicles are still more prevalent. Until electric or alternative energy vehicles (like hydrogen) become the majority, gas stations will continue to play a crucial role in terms of economic and land use.

1.4. Spatial distribution of the gas stations

There are currently 60 gas stations in Timișoara (Figure 2), with most of them situated on the main access roads like the European road E70 (Calea Lugojului - Calea Șagului), the European road

E671 (Calea Aradului) and the national road 6 (Calea Torontalului). These roads are the high-traffic routes in and out of the city, making them ideal locations for building gas stations. However, four gas stations (#11, #48, #55, and #57) have been abandoned, and two (#54 and #59) could be mistaken for green spaces. Additionally, two former gas stations (#56 and #58) have been transformed into a park and an office building, respectively. Out of the 60 gas stations, five are located on the administrative territory of Ghiroda commune. These five gas stations were also considered for the study because they are situated on a main access route to Timișoara, namely E70. Therefore, there are currently 47 gas stations in Timișoara, out of which only one is solely for LPG refuelling. Timișoara has an approximate area of 101 km², resulting in a density of 2.15 gas stations per km². Of the 52 gas stations currently in use, 11 (21.15%) are in residential areas. Five of these 11 gas stations (or 9.62% of the total gas stations in use) do not comply with the minimum distance requirement as stated by Order 119/2014 and Order 174/2005. Sixteen gas stations, which account for 30.77% of the total gas stations in use, are located near residential areas, primarily combined with commercial spaces, educational buildings, and sports and leisure facilities. Of these 16 gas stations, ten facilities (62.5%) do not meet the distance requirements. The remaining 25 gas stations (equivalent to 48.08%) are near office and administrative buildings, commercial, sports and leisure facilities, and accommodation spaces. Out of these 25 gas stations, only four (16%) fail to meet the distance requirements.

Therefore, out of the total of 52 gas stations in use, 19 (equivalent to 36.54%) do not meet the minimum distance requirements imposed by Orders 119/2014 and 174/2005 (Figure 2). Among the abandoned gas stations or those sites that have changed their functions, five are located in residential areas, near commercial spaces, buildings with public

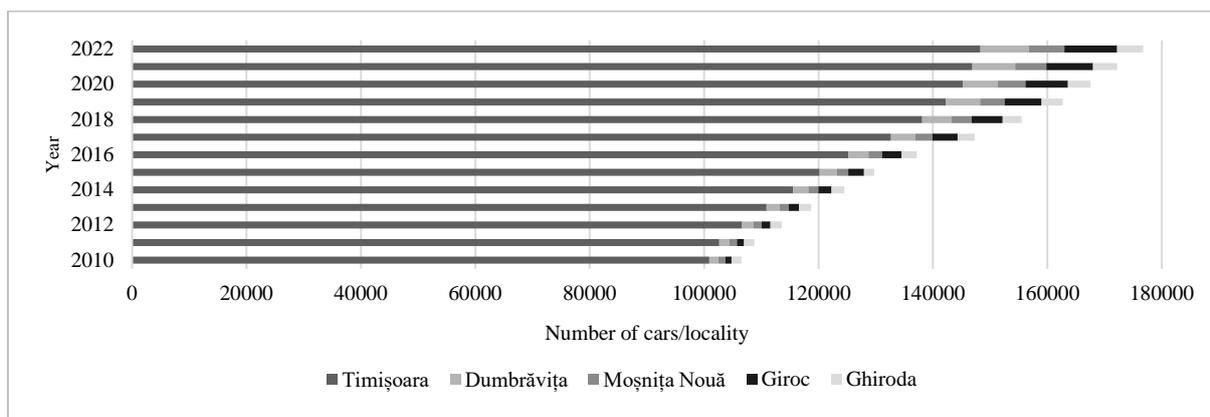


Figure 1. Number of cars registered in Timișoara and neighbouring localities (2010-2022). Source data: General Directorate for Driving Licenses and Vehicles Registration

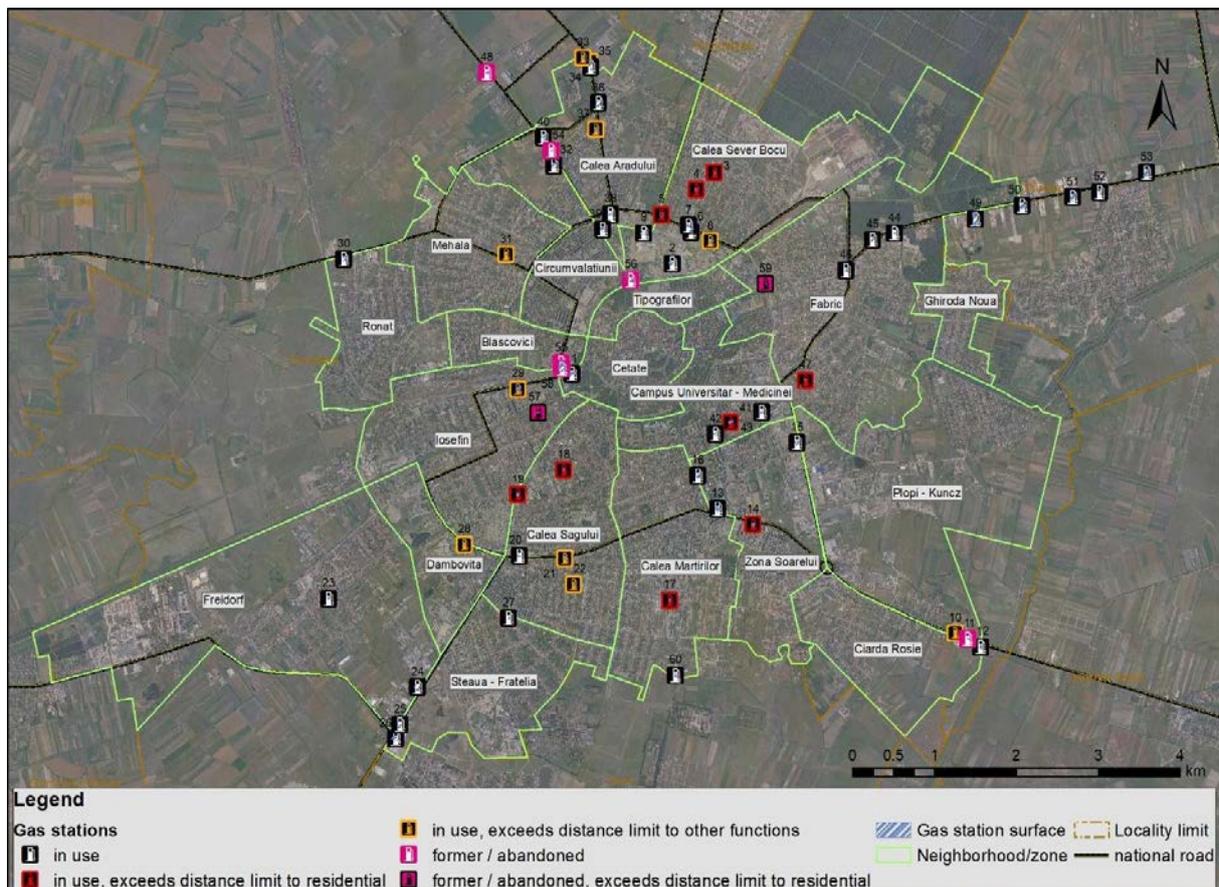


Figure 2. Location of gas stations in Timișoara

affluence, or green and leisure spaces. However, only two of these gas stations (#57 and #59) did not comply with the current legislation's minimum distance requirement.

2. METHODOLOGY

The current study is based on a research methodology known as triangulation, which involves using mixed qualitative and field methods to draw conclusions (Chelcea, 2001; Clifford et al., 2010). In geography, questionnaire surveys have been used to explore people's perceptions, experiences, behaviours, and spatial interactions in various geographical contexts (Clifford et al., 2010).

To gather citizens' perceptions of gas station locations in Timișoara and the potential conflicts associated with them, 141 structured questionnaires were completed. The survey was conducted in phases, starting between July and October 2020 during the coronavirus pandemic. The questionnaire was distributed in person and online via Google Forms to various public groups concerned with environmental issues in Timișoara. Given the social distancing restrictions at the time, the survey was conducted randomly, with 64 responses from the online

application and 37 from the in-person application. The questionnaire was repeated a year later, from July to August 2021, yielding 29 online and 11 in-person responses. Despite lacking control over the target audience, the online questionnaires allowed for a diverse group of respondents of varying ages, educational backgrounds, and activities. In the second phase, ten gas station managers from the most important fuel distribution companies agreed to participate in semi-structured interviews conducted in June 2022. The goal of interviewing the managers was to obtain more relevant data on compliance with environmental and fire safety measures and measures to mitigate negative effects at both the station and company levels.

Data on gas stations' locations and proximity to residential and other functional areas (such as educational buildings, sports facilities, office spaces, administrative buildings, etc.) were collected during field visits. Google Maps and a GPS Coordinates app installed on a mobile phone were used to collect this data. All gas stations, including abandoned ones, were publicly accessible, and there were no problems accessing them. The distance between any two gas stations was calculated using ArcMap's Generate Near Table function within a maximum radius of 500

meters. The near distance, which represents the shortest distance between two gas stations, was calculated in meters between the property limits of each gas station using the Geodesic method parameter. An orthophoto plan, on which all the gas station locations were marked, was used to map the gas stations. Public information on each property was obtained from the National Agency for Cadastre and Land Registration's integrated cadastre and land registry information system.

Gas stations have been mapped to verify if compliance with the 15-meter safety distance required by Order 119/2014 between gas stations and nearby residential properties is met. As such, a polygon shapefile was created in ArcMap to represent the property limit of each gas station. A 15-meter buffer was generated around each gas station perimeter to determine whether all facilities respect the minimum distance from the gas station to the windows of residential buildings. The accuracy of the validation process was ensured by verifying the minimum distance between gas stations and different buildings on-site using a laser distance meter with limits between 0.05 and 80 meters, model RZ-S80.

Moreover, a series of articles provided by the local media was analysed to identify potential events at gas stations that could endanger the safety and security of citizens. Media content analysis is a common method in environmental conflict research due to its ability to convey information to stakeholders. Janelle and Milward used information from mass media to develop a quantitative methodology for studying the conflict (Janelle & Millward, 1976; Janelle, 1977) and to create various cartographic representations. To identify incidents of fire affecting gas stations in Timișoara, local news available online, for instance, opiniatimisoarei.ro, www.tion.ro, and pressalert.ro have been consulted.

2.1. Study limitations

Several limitations of the study were encountered during the research documentation. Both survey phases were conducted amidst the coronavirus pandemic, resulting in a low response rate to the questionnaire. Although the original plan was to apply the questionnaires to operators and cashiers employed at different gas stations, due to their reluctance and lack of knowledge on some aspects related to the existing gas station operation permits, gas station managers were chosen instead. Moreover, obtaining information from the Environmental Protection Agency other than what was publicly available on their website was difficult.

3. RESULTS AND DISCUSSIONS

Given the significant number of buildings in Timișoara, it is essential to carefully consider the proximity to the neighbouring functions when proposing a new development project. For example, inadequate distances between gas stations and residential buildings can lead to conflicts due to noise or air pollution, fires or explosions. Conflicts arising from inadequate distances of gas stations from residential areas are rooted in the residential dynamic, as Pîndaru et al., (2021) noted. Therefore, relevant legislative instruments and authorities must exercise control to prevent potential. As depicted in Figure 2, gas stations in Timișoara are not evenly distributed along major roads. 37.3% of gas stations do not comply with the minimum distance of 15 m from residential and other urban functions, as required by Orders 174/2005 and 119/2014. This value is lower than that recorded in sector 4 of Bucharest, which is 85% (Pîndaru et al., 2021). It is also lower than what has been recorded in Zambia, where the non-compliance rate is 77.38% (Taylor et al., 2016) or in Nigeria, which has a rate of 98% (Mohammed et al., 2014) and 100% (Arokoyu et al., 2015; Olufayo, 2018).

As Iojă & Tudor (2012) noted in other cases, the high demand for spaces to construct individual and collective housing in Timișoara has led to their expansion near gas stations along principal urban transport axes. Furthermore, permanent, irregular and inappropriate urban development has become a common problem specific to urban settlements today, and the economy-ecology ratio instead favours economic interest (Brueckner et al., 2001). This highlights the resource conflict identified by Campbell (1996). The goal is to achieve a (functional) balance. Still, one of the priorities will always take precedence, depending on the subjectivity of those in charge, trends and the most critical needs of society (economic, environmental or societal).

3.1. Spatial distribution of gas stations in relation to each other and the possible conflicting association

Although there are regulations, such as Order 174/2005, which set minimum distances between gas station tanks, fuel pumps, or vent pipes and specific buildings, installations or developments like residential premises, buildings with public affluence, roads, tram lines, or industrial buildings, there are no such regulations in Romania to specify minimum distances between two gas stations. In contrast, gas stations in Nigeria and Ghana must be at least 400 meters apart (Arokoyu et al., 2015; Mshelia et al., 2015;

Table 1 Distance classes and ranks between gas stations

Rank/Distance	0 - 50 m	50.1 - 100 m	100.1 - 200 m	200.1 - 300 m	300.1 - 400 m	400.1 - 500 m	Total
Rank 1	4		7	6	5	1	23
Rank 2		2	1	3	2	4	12
Rank 3					2	3	5
Rank 4					1	3	4
Rank 5						3	3
Total	4	2	8	9	10	14	47

Peprah et al., 2018). Similarly, in Kuwait, the government, through the Road Engineering Department of the Ministry of Interior Affairs, has stipulated a minimum distance of 500 meters between petrol stations (Aleisa et al., 2014). Using the Near Table function in ArcMap, 33 gas stations (in use and former gas stations) were identified to be within a 400 m radius of each other, and 44 gas stations within a 500 m radius. These 44 gas stations represent about 73.3% of all gas stations considered in this study. Out of these, 42 gas stations are in Timișoara, and two are on the access route from Calea Lugojului (Ghiroda area) (#51 and #52). Depending on the level of proximity between the gas stations, several categories can be identified, with Near Rank representing the value of the category marking the distance between the gas stations (Figure 3, Table 1). For instance, the gas station closest to another one is considered Rank 1, while the next nearest has a value of 2. The highest value considered for this study is Rank 5. This gives 47 cases (unique values, duplicate values are removed from the table) where distances of less than 500 m between the perimeter of gas stations have been identified (Table 1), most of which are in the Rank 1 category (23 gas stations, i.e., 38.3% of the total gas stations), respectively Rank 2 (12 gas stations, which represents 20% of the total gas stations).

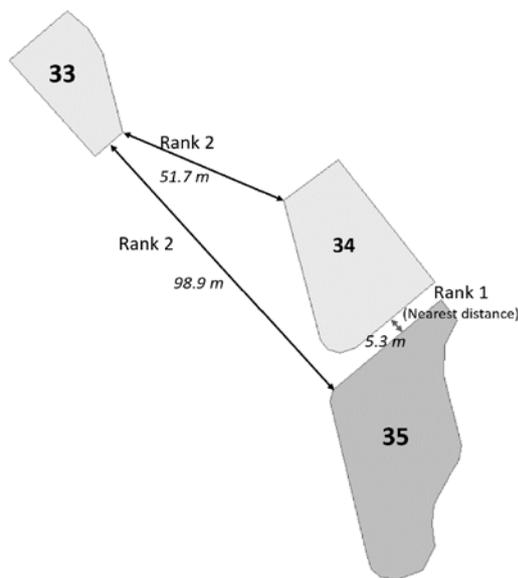


Figure 3. Distance and rank between gas stations

It should also be noted that seven cases entail proximity to a former gas station (five cases - Rank 1, one case - Rank 2, and one case - Rank 5). Out of the 47 cases considered, six represent gas stations between which distances less than 100 m were identified (Table 1). Situations where the distance between gas stations is less than 50 meters are all categorized as Rank 1. The distance between the perimeters of the two closest gas stations in use is 5.3 meters, measured between stations #34 and #35 (as shown in Figure 3). The distance between two former fuel stations, #55 and #58, is even smaller, measuring only 2.8 meters. At the time, an office building had been constructed on site #58, while #55 was not completely decommissioned.

3.2. Analysis of environmental and safety concerns of the population in relation to the distance findings

The normal operation of gas stations can expose three main groups of the population, namely: i) gas station employees (occupational exposure), ii) customers during the refuelling of vehicles, iii) those who live or work near a gas station, and are exposed passively (Hilpert et al., 2015). Of the surveyed citizens who reported living near a gas station or a facility related to vehicle maintenance, they do not consider these facilities as conflicting, mentioning their necessity for daily activities. These citizens consider gas stations as an essential aspect of their mobility, similar to the situation in Bucharest, as stated by Ioja & Tudor (2012) and Pîndaru et al., (2021). According to the survey data, people are more concerned about environmental pollution caused by large industrial companies than other economic activities such as gas stations, supermarkets, and medical infrastructure.

Gas stations can cause discomfort or health risks to the public due to their operations. Therefore, it is recommended that they be situated at a distance of at least 15 meters away from the windows of residential buildings, be it individual dwellings or blocks of flats. Figures 4 and 5 show the measured values for two gas stations, which comply with the minimum distance accepted by Order 119/2014 and 174/2005, respectively. Figure 6 presents an example



Figure 4. Gas station no. 46, located on Calea Dorobantilor (a.), distance from the residential area (b.), laser distance meter indicating the distance from the limit of the gas station to the residential area (c.)

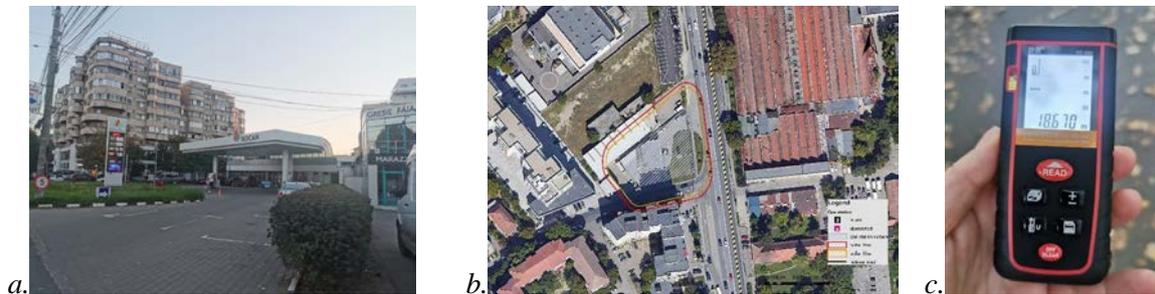


Figure 5. Gas station no. 37, located on Calea Aradului (a.), the distance from the residential area (b.), laser distance meter indicating the distance from the limit of the gas station to the residential area (c.)



Figure 6. Minimum distances between gas stations and individual dwellings exceeded according to Order 119/2014 but respected according to Order 174 / 2005

of minimum distances between gas stations and individual dwellings that are exceeded according to Order 119/2014 but respected according to Order 174/2005. Safety distances should be respected to reduce the propagation of events both outside the station if the event occurs on-site and towards on-site objects if the event occurs outside the station.

None of the survey participants reported being consulted about the plans to construct gas stations. Around 34% of the respondents mentioned that they were aware of the proposed gas station projects. Among the 141 participants, 12.1% expressed disapproval of having gas stations in their neighbourhood due to pollution and the potential risk of fires or explosions. On the other hand, most respondents (87.9%) welcomed the idea of gas stations as they are considered a valuable service for citizens. The survey participants also agreed that gas stations are

vital for a modern city; they offer convenience to locals, create job opportunities, and save them from travelling long distances to refuel their vehicles. During the assessment, it was found that nine gas stations are located within 15 meters of the residential buildings' façade (Figure 2). This situation may be due to construction restrictions introduced over time or the modified regulations, as with Order 174/2005 concerning tall and crowded buildings.

The study investigated whether the gas stations built after the implementation of Order 119/2014 comply with the minimum distance regulation. For instance, gas station #46 was built after the enforcement of this order, and the limit of 15 meters is respected (Figure 4). Similarly, gas station #37, built before 2014, complies with the minimum distance (Figure 5). However, three gas stations were found to be located near individual residential

buildings where the distances are less than 8 meters, which is the limit for individual homes. During the field study, it was found that the 8 m distance is respected for 2 of them, with only one gas station having a distance of 7 m (Figure 2). However, it is essential to note that these regulations may change over time, such as in the case of tall, very tall, and crowded buildings (Order 174/ 2005) or when new regulations take priority over those already in force (Figure 6). According to information on the Timișoara City Hall website, only two out of ten gas stations built after 2000 meet Order 119/2014 requirements. These two gas stations were built after 2014 and had to comply with the minimum distance of 15 meters from the limit of the gas station to the façade of residential spaces (gas station #46, project from 2015, and gas station #26, project from 2018-2019). However, the year of construction for the other gas stations could not be identified from the public information, but discussions with the gas station staff revealed that many of them were built after 2000.

Regarding the minimum distance of 15 m required by Order 119/2014, gas station #46, a project proposed in 2015, was one of the cases where citizens showed some involvement concerning such a proposed project. Around 60 directly affected individuals shared their objections and suggestions about the investment proposal during the public information and consultation phases. Most of them were concerned about pollution resulting from the proximity of their homes to the gas station. The proponent provided a reasoned response to each objection (Table 2). The opposition expressed by a few citizens in public consultations often represents the fears of the entire community.

When citizens do not participate, it can lead to flawed decisions regarding urban development. Unlike gas station #46, the gas station #26 project

received no notifications or comments during the public information and consultation phase.

3.3. Gas stations and fire hazards

Gas station fires have resulted in over 2.3 million fatalities and \$4.5 billion in property damage, according to Ainsworth & WHO (2004). According to the local press, six gas station fires have been identified in Timișoara (Table 3). Four incidents occurred inside the gas stations, while the remaining two were caused by cars parked near them. Most events were recorded in Calea Torontalului, a street with heavy vehicle traffic. Although the damages caused by the incidents listed in Table 3 seem minor, it is important to note that fires can pose a significant risk to public safety and adversely affect the environment by releasing pollutants into the air, or the fire may spread to nearby buildings. The higher the number of potentially hazardous equipment (such as fuel pumps in gas stations, LPG fuelling systems in motor vehicles, and points of sale for gas stove cylinders (Table 4), the greater the fire risk. In Timișoara, the gas stations have, in general, between 1 and 5 fuel pumps, with most of them being multi-product double gas pumps. Seventeen gas stations (i.e., 32.7%) have LPG distribution tanks and gas stove cylinders sold in 29 gas stations (i.e., 55.8% of all gas stations in use).

The fires that broke out in gas stations located in Timișoara, as listed in Table 3, have been successfully located and extinguished. In this regard, planning, land use and zoning regulations are in force to prevent and manage urban fires, as in other countries (Chang et al., 2010; Oppong et al., 2016; Amoako et al., 2022). According to the current legislation, gas station operators are required to take proactive measures to prevent any potential negative consequences on the environment and population. They must also

Table 2. Objections of potentially affected people and responses of the project proponent during the public information and consultation phases (data source: www.primariatm.ro)

	The problem complained of	Response from the project proponent
1	Proximity to residential area	The property boundary is 20.84 meters from the nearest residential building, meeting the legal requirements.
2	Impact of hydrocarbon emissions on air quality	The technology used in the facility includes effective measures to limit hydrocarbon emissions into the atmosphere.
3	Impact of exhaust gas emissions on air quality	The operation of the facility does not result in an increase in traffic, and the permitted limits for the following chemical pollution indicators are not expected to be exceeded: SO ₂ , NO _x , and NH ₃ .
4	Noise pollution	The technology and equipment used in the facility are not sources of noise pollution. The operation of the fuel pumps and other equipment within the station does not exceed the limits allowed by law for noise and vibrations. The only source of noise is the fuelling equipment, but this noise can be considered insignificant due to the background noise pollution from traffic in the surrounding area.

Table 3 Fires occurred in the area of gas stations

Date	Location	Cause of fire	Article title (translated)	Source/online media
26 June 2008	Calea Torontalului	The air conditioning system malfunctioned	Panic and smoke on Calea Torontalului	www.tion.ro
25 February 2012	Calea Torontalului	The fire broke out due to homeless people	Fire at an abandoned gas station on Calea Torontalului in Timișoara, in a neighbourhood of blocks of flats	opiniatimisoarei.ro
24 October 2013	Complexul Studentesc	Workers' equipment caused sparks that ignited the fire.	Risk of explosion at a gas station in Timișoara. A petrol tank was engulfed in flames.	ziare.com
13 August 2018	Calea Torontalului	A moving car caught fire	Heavy fire in a car on the way to a gas station in Calea Torontalului in Timișoara	www.tion.ro
11 November 2020	Calea Torontalului	A car parked near the gas station caught fire.	Fire at a car parked near a gas station in Timișoara	www.pressalert.ro
4 July 2022	Zona Lunei	a refrigerator caught fire	Fire at a gas station in Timișoara. The station shop flooded with smoke.	www.opiniatimisoarei.ro

Table 4. Number of fuel distribution pumps, gas stations with LPG fuelling systems for vehicles, and gas stations that sell gas stove cylinders

Number of fuel pumps per gas station	0 or abandoned	1-2	3	4-5	TOTAL
Gas Stations	9	15	27	9	60
LPG STATIONS	1	2	8	6	17
Gas cylinders	0	9	13	7	29

implement corrective measures if necessary. As for complying with legal requirements regarding the distance between a gas station and other building types, the most restrictive distances are applied to tall, very tall, and crowded buildings that have large public affluence, such as accommodation, cultural, financial-banking, educational, administrative, or blocks of flats. This is because a considerable number of citizens are at risk in such buildings. For individual houses, only a minimum safety distance of 5 meters is required for underground tanks and 6 meters for distribution pumps (Order 174/2005).

The gas station managers who were interviewed confirmed the attention given to fire management. They reported various measures in place, such as having fire extinguishers/hydrants at the facility key points, regularly checking tanks, providing training for employees, providing regular (annual) training for occupational health and safety, training provided by the Emergency Inspectorate, verification and calibration of tanks every ten years, yearly or 2-year VOC measurements, fire protection systems, placement of fire extinguishers as required in the fire safety permit, regular (quarterly) checks/verifications of operations/installation, and ensuring fuel unloading/transfer is done within parameters, respecting the transfer process. There is also vapour recovery equipment on the site.

The main aim of the interview with gas station managers was to assess the gas stations' compliance

with environmental and fire safety regulations. Additionally, the interview aimed to understand the perception of station workers regarding the physical, chemical, or toxicological risks they are exposed to during working hours. Based on the discussions, it was found that the gas stations comply with the regulations required for proper operation, including the environmental permit, fire safety permit, regulations governing the design, execution, operation, decommissioning, and post-use of gas stations, environmental management systems, and occupational safety standards. There are also emergency response and intervention plans for various events, such as fuel spills, fires, or explosions. These plans clearly outline the responsibilities of each employee and their actions to control the situation or mitigate adverse effects. The plans are accompanied by emergency response materials and equipment, and workers are trained regularly for emergencies based on various scenarios.

Underground fuel tanks can corrode over time and cause fuel leakage, which can contaminate soil and groundwater. However, regular inspections of tanks and the implementation of safety measures can prevent environmental risks. Workplace accidents can be dangerous and can cause serious harm. To prevent incidents, employees are trained regularly to respond to an incident. There are specific training scenarios for different events, such as a fuel pump fire, a fire at the LPG filling station, an earthquake, etc. A fire can have

severe consequences and threaten public safety, not to mention the negative environmental impact due to the release of significant air emissions. It's important to note that fire events in gas stations in Timișoara were rare, especially in recent times (Table 3), which is confirmed by the station managers interviewed. During interviews, it was also mentioned that vapour recovery systems had been installed to prevent emissions during storage tank refuelling, collect the vapours released during vehicle refuelling and redirect them to the underground tanks. One of the gas station managers raised an important issue regarding developing residential properties near existing gas stations. He pointed out that if the relevant authorities approve the project, then the legal requirements are met. The authorities are the primary decision-makers for implementing plans proposed by investors. However, conflicts are possible, as an environmental impact assessment is conducted before building such facilities.

4. CONCLUSIONS

Potentially conflicting associations with residential areas can often be found in cities, such as industrial sites, landfills, gas stations, convenience stores, and construction sites. Although these facilities are necessary parts of residents' lives, it is essential to acknowledge that these land uses can also harm the environment and the health and security of the population. This raises the question of why not all of these uses are associated with risks to the health and safety of citizens. People are often less aware that they live near a facility that may cause discomfort (e.g., a convenience store, a hospital) or may pose a safety hazard (e.g., a gas station) than that they live near an industrial site that generates pollution or that they work in a polluted environment (unrecognized vs. recognized hazard). For example, while no significant fire events have been recorded so far at gas stations in Timișoara, this type of hazard must always be considered.

The current study focuses on understanding how people perceive potential environmental conflicts, particularly regarding the distance between gas stations and residential areas and the health and safety issues that could arise. Gas stations offer many advantages but can cause problems when built too close to residential areas. Fortunately, there are laws and regulations that must be followed when a new gas station is proposed. In Timișoara, gas stations are typically located on the main access roads. As the city expanded, gas stations were built, which could lead to conflicts with new residential areas. When clustered, gas stations can have an even greater impact on the surrounding area. The same applies to gas stations near

industrial facilities that emit significant pollution. In such cases, authorities should consider how multiple sources of pollution could affect the area.

In the workplace, employees must undergo safety training that includes information on the risks they may be exposed to. However, residents living near gas stations may not always be aware of potential hazards such as exposure to noise or hazardous substances. This lack of awareness can lead to harmful situations in an emergency, as people may not know how to react. To prevent this, fire and hazard training programs currently implemented at gas stations should also be extended to citizens living or working nearby. However, it is possible that such training may not be well-received by the public, a situation similar to the lack of involvement from local communities in decision-making processes involving certain urban development projects. The lack of citizen participation in decision-making can lead to compromised decisions about urban development. Also, when citizens are not prepared for emergencies such as fires, explosions, or fuel spills, the affected area can suffer significant negative impacts.

Having gas stations located nearby can discourage potential investors in residential areas or potential dwelling buyers. This can lead to a vicious circle where unattractive neighbouring land uses deter investors, and the lack of investment negatively affects the sustainability of the neighbourhood or surrounding area. However, if the financial and social benefits of a particular development outweigh the negative environmental consequences, citizens tend to implicitly accept an activity located in the vicinity or within residential neighbourhoods. This approach can also be applied in the case of an event at a gas station; if citizens are not directly affected, they are less likely to take action in an emergency.

Acknowledgement

This paper and the research behind it would not have been possible without the support of my supervisor, Prof. Univ. Dr. Habil. Mircea Voiculescu.

REFERENCES

- Adewuyi, G.K.**, 2020. *Assessment of Fire Service Station Response to Filling Stations Fire Outbreak and Vulnerable Healthcare Centers to Filling Stations in Urban Settlement*. International Journal of Research and Review Vol.7; Issue: 3, 10-30.
- Afolabi, O.T., Olajide F.O. & Omotayo, S.K.**, 2011. *Assessment of Safety Practices in Filling Stations in Ile-Ife, South Western Nigeria*. Journal of community and primary health care, 23, 1-2, 9-15.
- Ainsworth, R. & World Health Organization**, 2004.

Safe Piped Water: Managing Microbial Water Quality in Piped Distribution Systems. edited by Richard Ainsworth, World Health Organization. <https://iris.who.int/handle/10665/42785>

- Ajman, N.N., Zainun, Y.N., Sulaiman, N., Khahro, H.S., Ghazali, M.E.F. & Ahmad, H.M.,** 2021. *Environmental Impact Assessment (EIA) Using Geographical Information System (GIS): An Integrated Land Suitability Analysis of Filling Stations.* Sustainability, 13(17), 859. <https://doi.org/10.3390/su13179859>.
- Aleisa, E., Savsar, M., Al-Mashaan, M.M., Al-Jadi, A. & Al-Sabah, A.S.,** 2014. *A metaheuristic approach for location of gas stations in a metropolitan area,* International Journal of Operational Research, 21(2), 172. <https://doi.org/10.1504/IJOR.2014.064543>.
- Amoako, C., Adamtey, R. & Doe, B.,** 2022. *Fire risks management in emerging Ghanaian cities: land use planning responses for siting petrol and gas stations in the Tamale Metropolis.* GeoJournal, 87:3065–3076. <https://doi.org/10.1007/s10708-021-10416-3>.
- Arokoyu, B.S., Mark, O. & Jochebed, O.A.,** 2015. *Petrol filling stations location and minimum environmental safety requirements in Obio Akpor LGA, Nigeria.* International Journal of Scientific Research and Innovative Technology Vol. 2 No. 11, 21-39.
- Batambock, S., Innocent, N.M., Bitondo, D. & Waffo, A.F.N.,** 2021. *Auditing the Siting of Petrol Stations in the City of Douala, Cameroon: Do they Fulfil the Necessary Regulatory Requirements?.* Advances in Science, Technology and Engineering Systems Journal Vol. 6, No. 1, 493-500. <https://doi.org/10.25046/aj060154>.
- Bowers, K.,** 2014. *Risky Facilities: Crime Radiators or Crime Absorbers? A Comparison of Internal and External Levels of Theft.* Journal of Quantitative Criminology, 30(3):389–414. <https://doi.org/10.1007/s10940-013-9208-z>.
- Brueckner, J.K., Mills, E. & Kremer, M.,** 2001. *Urban Sprawl: Lessons from Urban Economics (with Comments).* Brookings-Wharton Papers on Urban Affairs, Brookings Institution Press, pp: 65-97.
- Burgess, A.,** 2007. *Real and phantom risks at the petrol station: The curious case of mobile phones, fires and body static.* Health, Risk & Society, 9:1, 53-66, <https://doi.org/10.1080/13698570601181524>.
- Campbell, S.,** 1996. *Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development,* American Planning Association, Journal of the American Planning Association, 62(3), 296 – 312, <https://doi.org/10.1080/01944369608975696>
- Chang, C.C., Tsai, S.S., Chiu, H.F., Wu, T.N. & Yang, C.Y.,** 2009. *Traffic Air Pollution and Lung Cancer in Females in Taiwan: Petrol Station Density as an Indicator of Disease Development.* Journal of Toxicology and Environmental Health, Part A, 72:10, 651-657. <https://doi.org/10.1080/15287390902733515>.
- Chang, Y., Wilkinson, S., Seville, E. & Potangaroa, R.,** 2010. *Resourcing for a resilient post-disaster reconstruction environment,* International Journal of Disaster Resilience in the Built Environment. 1(1), 65–83. <http://dx.doi.org/10.1108/17595901011026481>.
- Chelcea, S.,** 2001. *Tehnici de Cercetare Sociologică - Curs.* Școala Națională de Studii Politice și Administrative, București
- Chiu, H-F., Tsai, S-S., Chen, P-S., Liao, Y-H., Liou, S-H., Wu, T-N. & Yang, C-Y.,** 2011. *Traffic Air Pollution and Risk of Death from Gastric Cancer in Taiwan: Petrol Station Density as an Indicator of Air Pollutant Exposure.* Journal of Toxicology and Environmental Health, Part A, 74:18, 1215-1224. <https://doi.org/10.1080/15287394.2011.590100>.
- Clifford, N., French, S. & Valentine, G.,** 2010. *Key Methods in Geography.* SAGE Publications, ISBN 978-1-4129-3508-1, ISBN 978-1-4129-3509-8.
- Correa, M.S., Arbilla, G., Marques, R.C.M. & Oliveira, M.P.G.K.,** 2012. *The impact of BTEX emissions from gas stations into the atmosphere.* Atmospheric Pollution Research 3, 163-169. <https://doi.org/10.5094/APR.2012.016>.
- Dukes, E.F.,** 2004. *What we know about environmental conflict resolution: an analysis based on research.* Conflict Resolution Quarterly, 22(1–2), 191–220. <https://doi.org/10.1002/crq.98>.
- Fowler, A.H.K. & A. Baxter, A.,** 2000. *Fires, explosions and related incidents at work in Great Britain in 1996/97 and 1997/98.* Journal of Loss Prevention in the Process Industries 13, 547–554. [https://doi.org/10.1016/S0950-4230\(00\)00008-5](https://doi.org/10.1016/S0950-4230(00)00008-5).
- Giovannoni, G.,** 2016, *The Social Life of Gas Station.* The Journal of Public Space, 1(1), 75-94, <https://doi.org/10.5204/jps.v1i1.12>.
- Groff, E.R. & Lockwood, B.,** 2014. *Criminogenic Facilities and Crime across Street Segments in Philadelphia: Uncovering Evidence about the Spatial Extent of Facility Influence.* Journal of Research in Crime and Delinquency, 51(3) 277-314. <https://doi.org/10.1177/0022427813512494>.
- Hamid, A.B., Iman, M.H., Suriatini, B.I. & Martin, R.B.T.,** 2009, *Site Potentiality of Petrol Stations Based on Traffic Counts.* Malaysian Journal of Real Estate, 4, 10–33.
- Harrison, M.R., Leung, P-L., Somerville, L., Smith, R. & Gilman, E.,** 1999, *Analysis of incidence of childhood cancer in the West Midlands of the United Kingdom in relation to proximity to main roads and petrol stations.* Occupational and Environmental Medicine, 56(11), 774–780. <http://dx.doi.org/10.1136/oem.56.11.774>
- Hemming, M.,** 2020. *Environmental Impact Assessment Report for an Application for Exploration Right for Petroleum.* Rhino Oil and Gas Exploration South Africa: Cape Town, South Africa, 19.
- Hilpert, M., Rule, A. M., Adria-Mora, B. & Tiberi, T.,** 2019. *Vent pipe emissions from storage tanks at gas stations: Implications for setback distances.* Science of the Total Environment, 650(2). 2239–2250. <https://doi.org/10.1016/j.scitotenv.2018.09.303>.
- Iojă, C.I. & Tudor, C.A.,** 2012. *Temporal Analysis of*

- Incompatible Land-Use and Land-Cover: The Proximity between Residential Areas and Gas Stations in Bucharest Suburban Area.* Procedia Environmental Sciences, 14, 49-58. <https://doi.org/10.1016/j.proenv.2012.03.006>.
- Iojă, C., Niță, M., Vânău, G., Onose, D., Gavrilidis, A., & Hossu, C.,** 2015. *Managementul conflictelor de mediu.* Editura Universității din București
- Janelle, D. G., & Millward, H.A.,** 1976. *Locational conflict patterns and urban ecological structure.* Tijdschrift voor economische en sociale geografie, 67(2), pp. 102–113. <https://doi.org/10.1111/j.1467-9663.1976.tb01391.x>.
- Janelle, D. G.,** 1977. *Structural dimensions in the geography of locational conflicts.* The Canadian Geographer/Le Géographe Canadien, 21(4), 311–328, <https://doi.org/10.1111/j.1541-0064.1977.tb01004.x>.
- Karakitsios, P.S., Delis, K.V., Kassomenos, A.P., Georgios A., & Pilidis, A.G.,** 2007. *Contribution to ambient benzene concentrations in the vicinity of petrol stations: Estimation of the associated health risk.* Atmospheric Environment 41, 1889–1902. <https://doi.org/10.1016/j.atmosenv.2006.10.052>.
- Khahro, H.S., Matori, N.A., Chandio, A.I., & Talpur, M.A.H.,** 2014. *Land suitability analysis for installing new petrol filling stations using GIS.* Procedia Engineering 77, 28–36. <https://doi.org/10.1016/j.proeng.2014.07.024>.
- Kitwattanavong, M., Prueksasit, T., Morknoy, D., Tunsaringkarn, T., & Siriwong, W.,** 2013. *Health Risk Assessment of Petrol Station Workers in the Inner City of Bangkok, Thailand, to the Exposure to BTEX and Carbonyl Compounds by Inhalation.* Human and Ecological Risk Assessment: An International Journal, 19:6, 1424–1439. <https://doi.org/10.1080/10807039.2012.685814>.
- Liu, D., Xu, Z., Wang, Z., & Fan, C.,** 2020. *Regional evaluation of fire apparatus requirements for petrol stations based on travel times.* Process Safety and Environmental Protection, 135, 350–363, <https://doi.org/10.1016/j.psep.2020.01.012>.
- Majumdar (néé Som), D., Dutta, C., Mukherjee, A.K., & Sen, S.,** 2008. *Source apportionment of VOCs at the petrol pumps in Kolkata, India; exposure of workers and assessment of associated health risk.* Transportation Research Part D 13, 524–530. <https://doi.org/10.1016/j.trd.2008.09.011>.
- Mäkká, K., Kampová, K., Loveček, T., & Petrlová, K.,** 2021. *An Environmental Risk Assessment of Filling Stations Using the Principles of Security Management. A Case Study in the Slovak Republic.* Sustainability 13(22):12452. <https://doi.org/10.3390/su132212452>.
- Masih, A., Lall, A. S., Taneja, A., & Singhvi, R.,** 2016. *Inhalation exposure and related health risks of BTEX in ambient air at different microenvironments of a terai zone in north India.* Atmospheric Environment, 147, 55–66. <https://doi.org/10.1016/j.atmosenv.2016.09.067>.
- Mshelia A.M., Abdullahi, J. & Dawha, D.E.,** 2015. *Environmental Effects of Petrol Stations at Close Proximities to Residential Buildings in Maiduguri and Jere, Borno State, Nigeria.* IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume 20, Issue 4, Ver. IV, 1-8. <https://doi.org/10.9790/0837-204440108>.
- Mohammed, M.U., Musa, I.J. & Jeb, D.N.,** 2014. *GIS-Based Analysis of the Location of Filling Stations in Metropolitan Kano against the Physical Planning Standards.* American Journal of Engineering Research 3(9), 147-158.
- Morales Terrés I.M., Miñarro M.D., Ferradas E.G., Caracena A.B. & Rico J.B.,** 2010. *Assessing the impact of petrol stations on their immediate surroundings.* Journal of Environmental Management, 91(12): 2754-2762. <https://doi.org/10.1016/j.jenvman.2010.08.009>.
- Mutungi, J.K., Moturi, W., & Makindi, S.,** 2019. *Occupational Safety and Health Management Systems and Their Compliance among Petrol Stations in Kenya: A Case Study in Nakuru County.* Current Journal of Applied Science and Technology, 37(2): 1-8, 2019; Article no.CJAST.50961, ISSN: 2457-1024. <https://doi.org/10.9734/CJAST/2019/v37i230275>.
- Nieminen, P.,** 2005. *Environmental protection standards at petrol stations: A comparative study between Finland and selected European countries* Tampere: University of technology.
- Olufayo, O.,** 2018. *Impact of location of petrol filling stations in Akure, Nigeria.* Journal of Emerging Trends in Economics and Management Sciences Vol. 9, No. 4, 192-200.
- Oppong, J. R., Boakye, K., Edziyie, R., Owusu, A. Y., & Tiwari, C.,** 2016. *Emergency fire response in Ghana: The case of fire stations in Kumasi.* African Geographical Review. <https://doi.org/10.1080/19376812.2016.1231616>.
- Onose, D-A., Niță, M.R., Ciocănea, C.M., Pătroescu, M., Vânău, G.O., & Bodescu, F.,** 2015. *Identifying critical areas of exposure to environmental conflicts using expert opinion and multi-criteria analysis.* Carpathian Journal of Earth and Environmental Sciences, Vol. 10, No 4, 15 – 28.
- Peprah, M., Boye, C., Larbi, E., Appau, P.,** 2018. *Suitability analysis for siting oil and gas filling stations using multi-criteria decision analysis and GIS approach – A case study in Tarkwa and its environs.* Journal of Geomatics, 158-166.
- Pîndaru L.C., Popescu B.I., & Niță M.R.,** 2012. *Comparative analysis on the role of vegetation in controlling the potential effects of gas stations on residential areas.* Forum geografic. Studii și cercetări de geografie și protecția mediului Volume XX, Issue 1, 34-42. <https://dx.doi.org/10.5775/fg.2021.032.i>.
- Sairat, T., Homwuttiwong, S., Homwuttiwong, K., & Ongwandee, M.,** 2015. *Investigation of gasoline distributions within petrol stations: spatial and seasonal concentrations, sources, mitigation measures, and occupationally exposed symptoms.* Environmental Science and Pollution Research, 22(18), 13870–13880.

<https://doi.org/10.1007/s11356-015-4615-3>.

- Semih, T., & Seyhan, S., 2011.** A Multi-Criteria Factor Evaluation Model for Gas Station Site Selection. *Journal of Global Management, Global Research Agency*, 2(1), 12-21.
- Taylor, T.K., Sichinsambwe, C., & Chansa, B., 2016.** *Public Perceptions on Location of Filling Stations in the City of Kitwe in Zambia*. *Developing Country Studies*, 6(6), 133-151.
- Torre, A., Melot, R., Magsi, H., Bossuet, L., Cadoret, A., Caron, A., Darly, S., Jeanneaux, P., Kirat, T., Pham, H.V., & Kolokouris, O., 2014.** Identifying and measuring land-use and proximity conflicts: methods and identification. *SpringerPlus* 3, 85. <https://doi.org/10.1186/2193-1801-3-85>
- Zahnw, R., 2018.** *Mixed Land Use: Implications for Violence and Property Crime*. *City & Community* 17:4, 1119-1142. <https://doi.org/10.1111/cico.12337>.
- Zhao, Q., Liu, M., & Chen, Q., 2017.** *The Impacts of Gasoline Stations on Residential Property Values: A Case Study in Xuancheng, China*. *Journal of Sustainable Real Estate*, 9:1, 66-85, <https://doi.org/10.1080/10835547.2017.12091901>.
- Weng, H-H., Tsai, S-S., Chiu, H-F., Wu, T-N., & Yang, C-Y., 2008.** *Childhood Leukemia and Traffic Air Pollution in Taiwan: Petrol Station Density as an Indicator*. *Journal of Toxicology and Environmental Health, Part A*, 72:2, 83-87, <https://doi.org/10.1080/15287390802477338>.
- Ordinul nr. 174/2005 pentru aprobarea Reglementării tehnice Normativ pentru proiectarea, executarea, exploatarea, dezafectarea și postutilizarea stațiilor de distribuție a carburanților la autovehicule, indicativ NP 004-03, publicat în Monitorul Oficial, Partea I nr. 34 din 13.01.2006
- Ordinul nr. 1395/2006 privind modificarea anexei la Ordinul ministrului transporturilor, construcțiilor și turismului nr. 174/2005 pentru aprobarea Reglementării tehnice "Normativ pentru proiectarea, executarea, exploatarea, dezafectarea și postutilizarea stațiilor de distribuție a carburanților la autovehicule", indicativ NP 004-03, publicat în Monitorul Oficial nr. 680 din 08.08.2006
- Ordinul nr. 119 / 2014 pentru aprobarea Normelor de igienă și sănătate publică privind mediul de viață al populației, publicat în Monitorul Oficial nr. 127 din 21.02.2014
- National Institute of Statistics (2023), available at <https://insse.ro/cms/ro/content/recens%C4%83minte>, accessed 17.07.2023.
- Normativ de proiectare, execuție și exploatare a sistemelor de alimentare cu gaze petroliere lichefiate (GPL) pentru autovehicule NP 037-99.

Received at: 22. 01. 2024

Revised at: 25. 04. 2024

Accepted for publication at: 08. 05. 2024

Published online at: 13. 05. 2024