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Data Article

Dataset on environmental impacts and costs of energy consumption in educational buildings in Iran

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ABSTRACT

With more than 1700 data rows, this data article presents data on the environmental and economic efficiency of educational buildings in 14 provinces of Iran. The presented dataset represents monthly data on climate change impact indicators such as Global Warming Potential, Acidification Potential, Human Health Particulate, Eutrophication Potential, Ozone Depletion Potential and Smog Potential. It also covers the history of monthly gas consumption and energy cost data for each school in each period read by the gas agent; In addition to the history of monthly weather information for each city/province. Information provided in this data article can be useful for research on energy prediction studies and also energy management strategies, as well as policymakers to achieve sustainability factors, and to choose the most suitable measures for educational buildings. Considering that few data sets have been published on this topic and in this type of climate, this dataset can be useful for researchers in sustainability and resiliency.

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Specifications Table

Subject	Engineering
Specific subject area	This dataset includes the monthly gas consumption in 31 schools in different cities across Iran. It also reports the amounts of carbon dioxide emissions resulting from it. Main Environmental indicators such as Global Warming Potential (GWP), Acidification potential, Human Health particulate, Eutrophication potential, Ozone Depletion potential and Smog potential were also calculated and reported. The lowest, highest, and average monthly dry bulb temperature of the location is also reported.
Type of data	Table Figure
How the data were acquired	• 20 schools were selected across the country. These schools represent academic buildings in Iran, in terms of their area, number of students, location, construction assembly, building shape, etc. • The geographic distribution is aligned with population distribution to provide reliable sample. • Then data related to the amount of monthly gas consumption in m3 has been collected from the website of Iran's National Gas Company. • The amounts of environmental indicators have been calculated using the intensity factor reported by Iran's Ministry of Oil. For accuracy and validation, the environmental impact factors where compared to the Athena impact estimator [1]. • To reflect the impact of climate on energy consumption and environmental impact, highest, lowest and average monthly temperature was also added to the dataset to boost the usability of data for other regions. • Payable amount was also available through Iran's National Gas Company records and was exchanged to USD for data usability by other users.
Data format	Raw Filtered
Description of data collection	• Characteristics of sample schools were collected using field measurement and observation. • The amount of monthly gas consumption has been obtained through the gas ID of the school (which is the code specific to that educational unit) on the website of Iran's National Gas Company. • The amounts of environmental indicators have been calculated using the intensity factor reported by Iran's Ministry of Oil for Iran's carbon intensity of natural gas [2]. • The Contaminant factor for Natural Gas is as follows: Global Warming Potential= 2.38E+00 [kg CO2 eq]Acidification Potential= 2.08E-02 [kg SO2 eqHH Particulate=1.29E-03 [kg PM2.5 eq]Eutrophication Potential=2.02E-04 [kg N eq]Ozone Depletion Potential=9.65E-13 [kg CFC-11 eq]Smog Potential=5.17E-02 [kg O3 eq] • The results of environmental impacts were then compared to the Athena Impact Estimator data for validation which showed similarity. • Operational cost was extracted from the record by Iran's National Gas and converted from IRR to USD. • The monthly weather information related to each city has been collected through the "timeanddate" website and added to the data set for applicability of data in other regions [3].

(*continued on next page*)

Data source location	• Institution: School • City/Town/Region: Tehran (Tehran province-Capital), Karaj (Alborz province), Qom (Qom Province), Zanjan (Zanjan province), Hamedan (Hamedan province), Semnan (Semnan province), Isfahan (Isfahan province), Yazd (Yazd province), Shiraz (Fars province), Kerman (Kerman province), Bukan (West Azerbaijan province), Mashhad and Kashmar (Khorasan Razavi province), Ardabil (Ardabil province), Tabriz (East Azerbaijan province). • Country: Iran • Latitude and longitude for collected data: (Iran) 32.4279° N, 53.6880° E GPS Coordinates of Tehran, Iran: DD: 35.69439 51.42151 DMS: 35°41′39.80" N 51°25′17.44" E GEOHASH: tnke41unbh8 UTM: 39S 538135.83756123 3950134.5491014
Data accessibility	Repository name: Mendeley Data identification number: 10.17632/6w6vv8n4tf.1 Direct URL to data: https://data.mendeley.com/datasets/6w6vv8n4tf [4].

1. Value of the Data

- In this dataset main Environmental indicators such as Global Warming Potential (GWP), Acidification potential, Human Health particulate, Eutrophication potential, Ozone Depletion potential and Smog potential were calculated and reported. Unlike the majority of datasets in this area that focused solely on GWP, this dataset encompasses diverse aspects of the environmental impacts of buildings and provides thorough insights on all environmental indicators.
- Real-time data can be used to build a machine-learning model to predict the energy consumption of educational buildings in Tehran or another city in the world that has a climate and urban texture similar to Tehran [5].
- The real-time data presented in this article are useful in the development of energy management strategies and for the design, measurement, modeling and simulation of energy systems in buildings to be constructed in the future or to be replaced in existing buildings.
- The data can be useful for the development of energy policies, comparative studies on other building types and selection approaches, or further analysis.
- The data are useful to follow the implementation of NZEBs (Nearly Zero Energy Buildings) and related technological measures.

2. Objective

Considering intensified environmental crisis in the past decade, the environmental impact of the buildings has gained attention in the research and academic communities and new technologies and methods such as ML have been deployed for designing low-impact buildings. Most of the prediction methods require training data and real data provide the most reliable training data set for prediction algorithms. Therefore there is a need to publish real data from building consumption to design a new generation of buildings with nearly zero environmental footprints.

On the other hand, the lack of real data from the Middle East has researchers with a gap. Therefore this research is conducted to collect and provide data on the environmental impacts of buildings in Iran for researchers and engineers in the low-carbon field.

3. Data Description

The data provided is collected from 31 schools in 14 cities in Iran. The data was collected using school gas bills and the history of gas consumption on the website of Iran's National Gas

Company. The history of monthly weather information related to each city has been collected through the "timeanddate" website [3]. Weather information includes the minimum and maximum temperature and the average temperature of each month when the gas consumption is read.

All schools are located in Iran. The school year in Iran starts in early October and ends in May (primary schools) or June (secondary schools). The school year mainly covers months with high heating demand. All schools use natural gas heaters for heating and hot water supply. The figure below shows the number and distribution of investigated schools in this dataset across 14 provinces of Iran (Fig. 1).

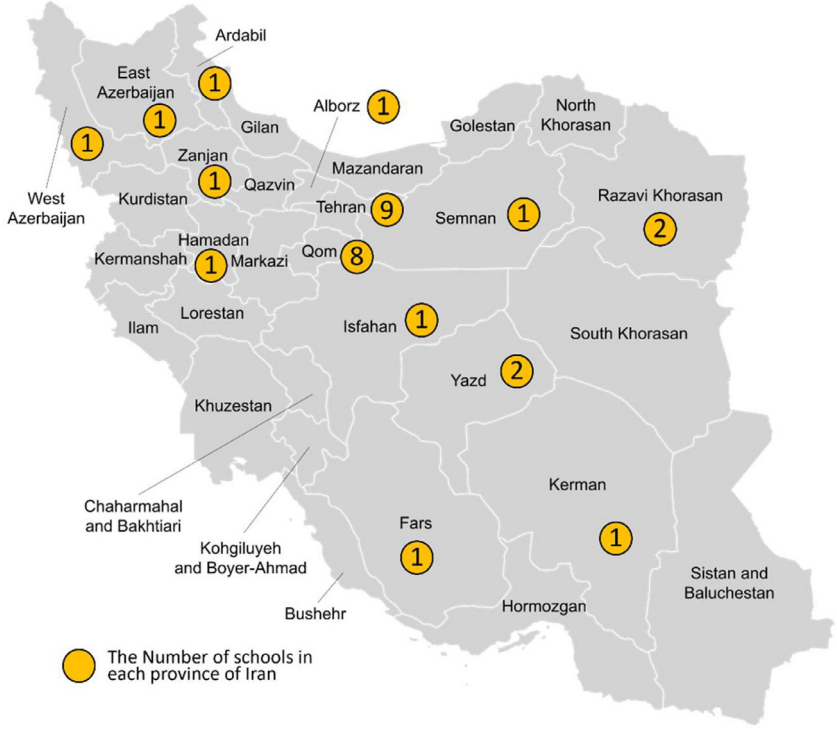

Fig. 1. The Number of schools in each province of Iran.

4. Experimental Design, Materials and Methods

The gas consumption records have been available for about 10 years, for most of the schools. Using gas consumption in m^3, environmental impact indicators were calculated using intensity factors. The presented environmental indicators in this dataset provide insight into GHG emissions, as well as impacts on Acidification, Ozone Depletion, Eutrophication, Human Health and Hazardous Photochemical Ozone Formation Potential emissions.

Considering the diverse impact of the built environment on nature, this data article has investigated the most important key performance indicators. In future studies, researchers can use this data to analyze and predict the energy consumption of educational buildings. In addition, with the spread of CIVID19 in 2020 and partial closures, it is important to evaluate the changes in gas consumption in each school considering different occupancy patterns during the pandemic in Iran.

Ethics Statements

All school principals who cooperated with the authors by sharing their school's gas bill did so with informed consent in order to assist the research. The information of the participants is completely anonymous.

Data Availability

Dataset on environmental impacts and economic performance of educational buildings (Original data) (Mendeley Data)

CRediT Author Statement

Mohammadsaleh Norouzi: Methodology, Data curation, Investigation, Writing – review & editing; **Sahar Labbafan:** Investigation, Data curation, Writing – original draft; **Bahareh Farajnia:** Investigation, Data curation, Visualization; **Mahsa Torabi:** Conceptualization, Methodology, Supervision, Validation, Writing – review & editing; **Mohammadreza Norouzi:** Investigation, Writing – review & editing.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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