Project Title: Development of a Comprehensive Atlas of Heating and solar Heating in the Building Sector

Department:	Plan of high-efficiency technologies for heating equipment in buildings	***Employer:***	Niroo Research Institute
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Project Necessity:

(Font: Times New Roman 12) Energy policy making in the building sector requires a clear picture of the current status. In that regard, energy consumption indices, statistical data of building distributions, solar radiation potentials, etc. should be considered simultaneously. For this purpose, a comprehensive national atlas of heating and solar heating in the building sector should be developed.

Project Goals:

This project aims to develop a comprehensive national atlas of heating and solar heating in the building sector based on statistical data, field study and simulations.

Abstract:

Due to different latitudes and variation of altitude in geographical areas in Iran, the climatic conditions of Iran are such that the variations of the heating degree-days are in a broad range of 60 to 3000 for residential buildings in different climatic regions. In addition, in many cases, the building design and construction processes follow patterns which do not necessarily meet national energy requirements and standards. Based on these two reasons, it is essential to identify the current status of energy consumption indicators in residential buildings. That way, it gets more convenient to adopt new strategies to improve the current state of energy consumption of buildings. In this project, heating energy consumption indices of residential buildings is investigated. Using the combination of the results of statistical data analysis, questionnaires, filled in for 500 buildings, and a reference building simulation in different climates of Iran, the heating atlas of residential buildings was prepared. According to the results, the average heating energy index of buildings in Iran can be less than 1 to more than 41.3(m^3 (N.G)/m^2.yr.) depending on climatic conditions and building design and construction quality. However, in the coldest center of province, the average of this index is 26.3(m^3 (N.G)/m^2.yr.) in the hottest one that is equal 2.2. The variations of the thermal base load (supply of hot water) varied from less than 13.12 to more than 378.84(m^3

(N.G)/Person .yr.). In provincial capitals, the lowest thermal base load index of buildings is 24.78 and the highest is 226.49 (m^3 (N.G)/Person .yr.) .In this study, beside charts and tables, results of heating energy consumption indices are also presented in the form of graphical atlases, i.e. color contour plots, to deliver a better picture of the whole country.

In the section of conducting studies for compiling a comprehensive solar atlas, in the first step, the requirements of design, simulation and arrangement of solar water heating systems were discussed. After examining the general modes of using collectors in supplying hot water to different floors of an apartment building, one of the most common modes of using solar water heaters is a system with central collector, central hot water tank (solar and storage), auxiliary heating system, along with pipes. Drawing to classes was selected for simulations. One of the most important input parameters in system design is the spa load. Therefore, two scenarios of hot water consumption, one 150 liters per day per person and the other based on the results of the heating base load atlas in different provinces were considered. The optimal slope angle of the collectors to receive the most solar radiation is also one of the factors that must be determined in proportion to each location.

Therefore, the optimal slope angles in 53 different cities of the country in the annual time periods, summer (April to September), and winter (October to March) were studied and presented in the form of an atlas. The results of the study of optimal slope angles showed that this number is a number close to the latitude of the place and is highly dependent on it. Also, the study of solar radiation potential on plates with optimal slope in different cities of the country once again showed that we have a good solar potential; So that almost all cities have an average of 4 hours of radiation per day. The results of this section, i.e. the amount of solar radiation on the plates with optimal slope in the three time periods of summer, summer and winter were presented in the form of atlas.

Finally, according to the mentioned cases and having two types of collectors, namely flat plate and vacuum tube, and considering two scenarios of hot water consumption, solar water heaters were simulated in different cities of the country, including provincial centers. Obviously, due to the higher efficiency of vacuum tube collectors, the required area per fixed solar share will be less than flat plate collectors. The results of this section are also presented in the form of an atlas.

The presentation of a comprehensive atlas of heating and solar heating in buildings has been one of the main results of this study. In the comprehensive atlas of heating in the field of construction, the equivalent amount of natural gas consumption that is used for space heating in residential buildings of the country is shown.

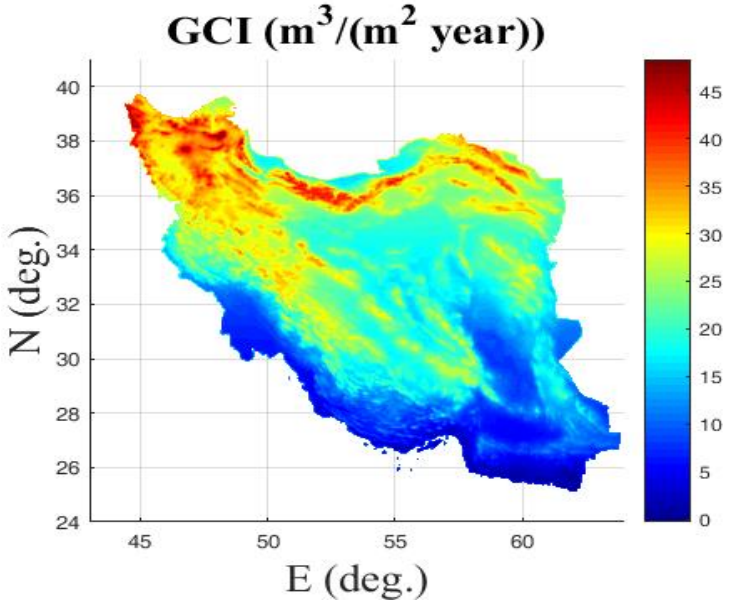


Fig1. Atlas of heating energy index of residential buildings in Iran

The following figure shows the equivalent amount of natural gas consumption that is used in Iran to provide sanitary hot water.

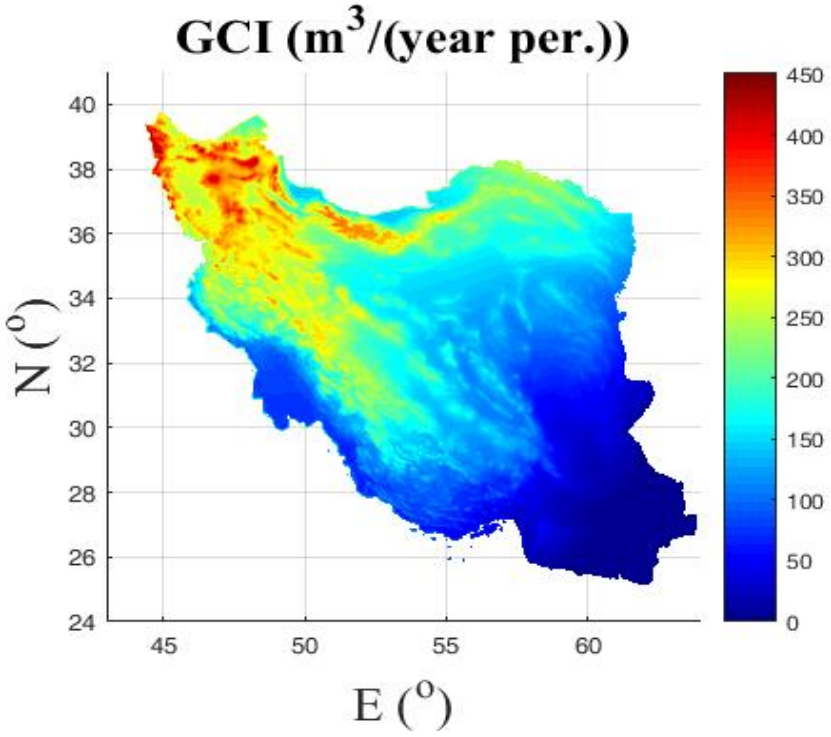


Fig 2. Atlas of heating base load of residential buildings in Iran

In the study section of compiling the solar heating atlas of the country in the residential building, the atlas of estimating the area of the collector of the flat plate and the vacuum tube to provide the heating base load of the buildings or to provide 150 liters per day of sanitary hot water are the main results of the project.

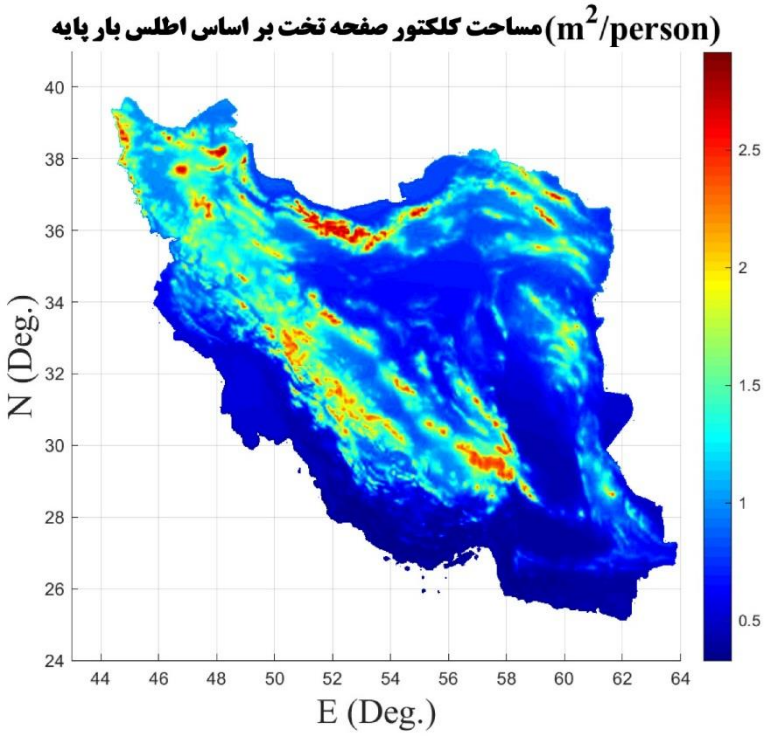


Fig 3. Flat plate collector area based on atlas of heating base load (m2 / person)

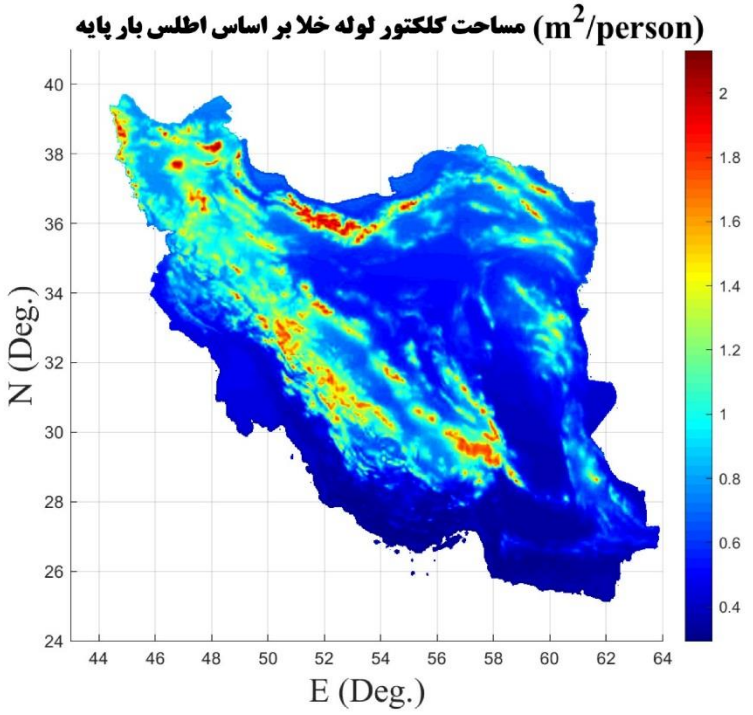


Fig 4. Vacuum Tube collector area based on atlas of heating base load (m2 / person)

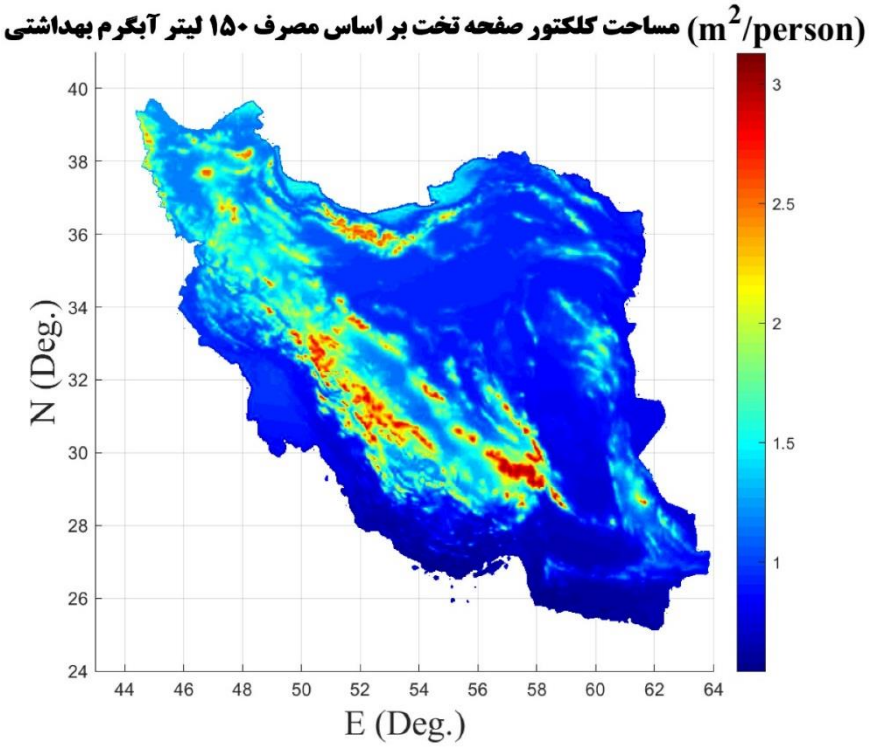


Figure 5: Flat plate collector area based on consumption of 150 liters of sanitary hot water (m2 / person)

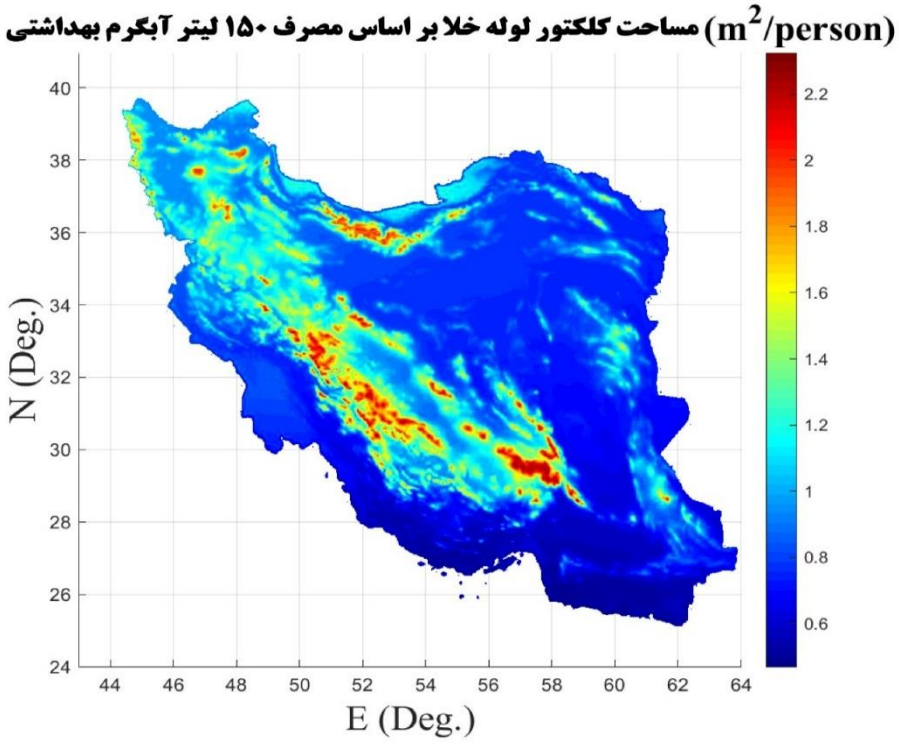
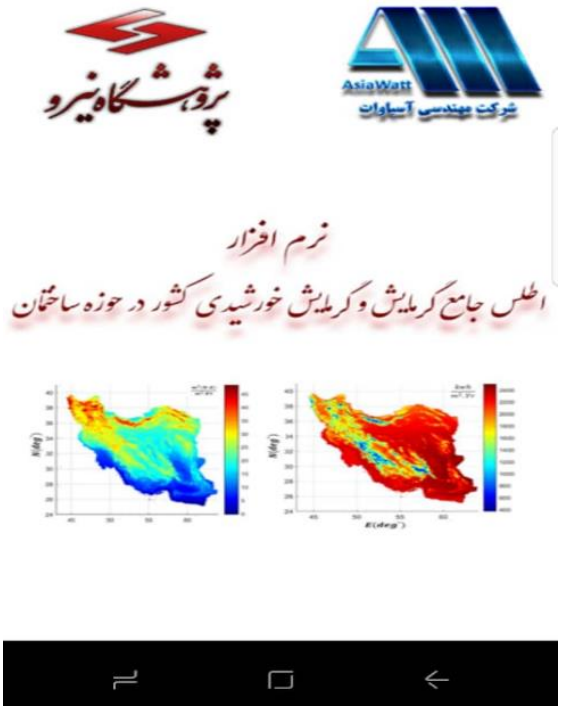


Figure 6: Vacume Tube collector area based on consumption of 150 liters of sanitary hot water (m2 / person)

The android version software of comprehensive atlas of solar heating and heating of the country has a complete bank of the geographical location of the cities and provinces of the country and provides the possibility for the user to select the desired city to analyze the energy consumption indicators of the residential building heating period in that area . It is also possible in the software to enter the geographical coordinates and altitude of a specific region that was not available in the database of cities in the country, the results of heating energy index and also the results of analysis of solar water heating systems in it.



Steps and Methodologies:

Steps:

1. Determination of heating energy demand, current consumption value and cost
2. Comparison of energy consumption indices with standard values and investigation of solar heating market status
3. Determing solar heating potentials, recommendation of executive solutions and atlas development

Methods:

- Statistical data gathering and analyses
- Building energy simulations
- Field study in the form of fill in questionairs
- Data sorting and numerical and graphical atlas development

Main Results (technical outputs, patents, papers, books, reports, etc.):

- ✓ Four technical reports plus one brief overall report
- ✓ One seminar presented in NRI
- ✓ One paper submitted to the journal of Building Simulation