Renewable Energy and Smart Hybrid Strategies for High Performance Architecture and Planning in Case of Tehran, Iran

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Abstract. It is significant to adopt renewable energy systems in building industry as one of the most important sectors in energy consumption. Level of energy consumption in building industry in contemporary architecture of developing countries such as Iran enjoys much more interest than other parts especially developed countries. Literature review of the research show that adoption of renewable energy systems has a lot to do with politics, policies, law, finances and market. While renewable energy finance and energy economics is in need of building sector to focus on adoption of renewable energy systems more than other sectors. It is very important to explain that high-performance architecture and planning requires some kinds of combined strategies to enhance the level of energy efficiency. The main scope of the research is to show concept of smart hybrid strategies for high-performance architecture and planning in case of Tehran, as one of the most important and efficient factors toward efficient adoption of renewable energy systems. The most important questions of the research are: 1- How socio-cultural and economic aspects of developing countries affect the idea of energy efficient architecture and planning? 2- What are the most important characteristics of high-performance architecture and planning for developing countries? Regarding to the hypothesis of the paper: 1- The idea of energy efficient architecture and planning in developing countries requires combined and smart hybrid strategies to meet energy efficient architecture and planning. 2- Smart hybrid strategies for high-performance architecture and planning consists of smart ventilation, photovoltaic systems, heat pumps, thermal storage, isolated building systems, low-e windows, efficient envelope and hyper-controlled openings.

1. Introduction
Climate change is a serious global environmental concern; it is primarily caused by the building up of green gases in the atmosphere. The global increases in carbon dioxide concentration and primarily due to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture. [1] Global warming is specific example of the broader term "Climate Change" and refers to observed increase in the average temperature in the air near Earth’s surface and ocean in the recent decades. According to the united nations, cities consume two third of global energy use. It was
emphasized that 76% of the world’s energy-related Carbon dioxide are also by cities by transport, industry, and building and construction related activities. Studies have shown that buildings and construction activities use 40% energy, 30% mineral resources and 20% water of world’s resources. It also accounts for 40% CO2 emissions, 30% solid wastes and 20% water pollution in the world. Energy and environment are critical constituents of physical development of the built environment. Energy conversation and environmental quality have been widely acknowledged as important parameters of building design. It is necessary to understand the strong interaction between architecture and physical development and establishes its importance with environment. [2] Therefore the energy conscious strategy for buildings emphasizes integration of several environmental factors, to achieve reductions in the use of conventional energy by desirable ventilation, utilizing day lighting and using appropriate thermal design of building. Today the subject of decrease in natural resources is one of the main issues in the policy of different countries. This subject is of one the main branches of each field of science and very important and inseparable part of architecture. Architecture and designers in the past considering their facilities and technology at that time had a very important role in this subject like form of the building, increasing or decreasing of the height of the building, and the stuff that they have used. The people in the house considering the seasons they used to live in different rooms and places of the building and this action led to using less fuel and more comfort. Today the issue of overpopulation of everyday life, lack of non-renewable energy resources and using renewable resources has an important role [2]. Part of this usage considering the chart-1 reaches to the highest level in residential buildings. Most of the energy usage includes lighting and heating, this subject has a straight connection with the environment, it puts the sensitive arts of the buildings like surface and sidewall in danger. So that the light transfer, air conditioning and the most heating exchanging happens from these sidewalls. If we consider these usages and overpopulation these resources will be gone in a short time. As a result, production and consumption need more energy and resources and it increases pollution.(Fig.1)

![Figure 1. Energy consumption by sectors][3]

During the past decade’s environmental issues were given a great attention from different aspects. The 1960s was the beginning of this attention and the main focus was on the pollution because of industrial development of that era was considerable [4]. In the late 1970s the issues of business and environment raised and the environmentalists held a lot of discussions all over the world against the development of business and its harmful effects on environment. In their opinion because of business freedom, increase in exports, pollutant activities and economic activities the usage of resources and energy will raise in an appropriate way [5]. In addition to energy crisis as the consumption increases so does pollution. Today pollution is one of the main managing struggles in a way that countries follow these issues internationally in addition to their inland policies. One of the examples of pollution is air pollution and because of its nature of development is noticeable all around the world. Without any doubt the air pollution is dependent
on the economic progress of countries. This subject in economic literature (environment literature) follows as EKC graph which shows the process of nature destruction considering the nature and different levels of economic progress. (Fig. 2)

2. Energy Consumption

2.1. Energy consumption in Iran

The building and housing sector with more than 40 percent of energy consumption is the largest energy consumer in Iran. The energy consumption of buildings in Iran is more than 5.2 times average global consumption. Along with major cities such as: Tehran has a high air pollution. That is often caused by the consumption of fossil energy. While more than 98 percent of the energy consumption of buildings in Iran will be provided of oil and gas products. The housing sector is one of the main sources of pollution. This sector allocated about 26.4 percent of the carbon dioxide emissions itself in Iran. Buildings in Tehran produces over 40 percent of carbon dioxide. Reduce energy consumption in the building and housing sector will have a significant impact on the total energy consumption of the whole country. [7] (Fig. 3-4)
Figure 4. the energy intensity in the household sector than in sector private consumption Koe / $ ppp [8]

Reduce energy consumption of buildings is imperative in terms of economic and environmental. Remove energy subsidies and increase in energy prices added to the importance of saving energy in buildings. In an architecture with high efficiency in energy consumption set rules and policies of government and organizations plays an important role, relevant organizations and government agencies shall provide scientific context and legal work and practical methods for achieving energy savings in buildings. The potential of energy saving in buildings housing more than other sectors and reduce energy consumption in this sector easier and with less investment available than other sectors. [9] believes the high demand for housing in Iran and the high potential of energy efficiency in new buildings and relatively low useful life of buildings in Iran all and all can be disabled using hybrid intelligent systems to save energy in their buildings. As the leading countries in this field, such as: Germany emphasis on reducing emissions in the building sector including new buildings and existing buildings. Establish the standard for energy efficient buildings in Iran need to technical and economic conditions specific to the use of standards and indirectly expertise organized in the relevant field for application of the principles. Iran Need to its own strategy in this field. [10]

The energy efficiency strategies in building and housing in Iran according to economic conditions, political, social, could be as follows: 1) Reduce energy consumption of buildings with architectural design, 2) Standards and energy labels for buildings, 3) Promotional support for the construction of energy efficient buildings, 4) Making culture to reduce energy consumption in buildings, 5) Construct pattern buildings, 6) The standards for energy consumption in buildings. Legislation and planning and preparation specified energy labels for various rankings adds to basic understanding of energy consumption in the building sector and separate from that, with increased public understanding and buyers of housing in this regard, increase the value of the transaction between vendors and buyers will find an approach and a factor such as the rate of energy exchange will be as part of the main criteria. To put it briefly stated, if a building is energy efficient is desirable goal to achieve this goal should be taken the main steps together with the intricacy to perfection or achieve lower power consumption achieved in buildings sector [10]. In this way, give advice to builders and buyers' awareness regarding the importance of obtaining high quality modest fee could be one of the main stages. Despite the high costs spent for such projects in the first place, amount of energy savings and economic benefits in the long run it is effective and profitable. Reduce waste and energy consumption maintain and store these resources and generate revenue through the sale of the state [11]. (Fig.5-6)
Another most important thing in energy consumption is behavior of the residents and users. Which has a significant impact on energy consumption in buildings. Simple tasks, making culture to change daily habits, using smart windows with low emissions and switching to simple windows, sealing doors and windows and replacement of structural elements undesirable and also other passive strategies can play an important role. Behavior affecting energy use in buildings can be named the following options: 1) Turn on and off to time cooling and heating systems, 2) Use curtains suitable for different rooms, 3) Opening and closing time according to performance and type of pop-up windows, 4) The use of heating and cooling systems in accordance with spaces and special programming for different conditions throughout the seasons. Application of these strategies in a residential area need to awareness of the circumstances and the responsibility of individuals to resources and its own national interests to consider more sensitive to the environment and energy consumption. It was very important attracting the public trust, good policy and financial support and regulation tailored to the goals of reducing energy consumption and the use of
renewable energy systems. It is considered as the basic and fundamental and this second part of sector collaboration with the type of energy and use to required mechanical systems compared to basic needs and the primary need and feasibility choices in the strategy will be an architecture with high efficiency. [13] One of the basic strategies for saving energy is optimization of design. What an optimized architectural design of the form and geometry involved design or intelligent systems in the design, also sought save resources and costs. If adherence to specific criteria based on the design and geometry, without increasing costs or scarce facilities and additional manpower that can bring countless problems, the ultimate goal achieved to reduce energy consumption or energy-efficient building design. This method can be used for different buildings and provide its needs over the life cycle of buildings. Including the impact of optimization of design can be noted in the opening system and climate use of special materials in different areas and preserving the dominant form of architecture region. In this type of design can be considered material apart from the architect. In this case considered amount of heat transfer coefficient materials. This field of design methods based to reduce environmental damage and reduce energy consumption [14].

3. Renewable Energy
Oil consumption in Iran has a constant slope increasing and manufacturing of that has been high volatility. According to international experts about the energy crisis, in the not too distant future, Iran will be importing oil. Renewable energy from substances such waste can be used as a strategy in the country is part of the energy consumption. Renewable energy to say which types of energy the kind of energy source, unlike renewable energies (fossil) it is the nature re-emerged in a short period of time, or be renewed. In fact, the energy from the sun, wind, biomass, geothermal, hydro, wave and tidal, biogas and liquid biofuels are renewable energies. As well as fuels derived from municipal solid waste, hospital and household waste such as tires, plastics, waste oil and other energy sources similarly are the energy from waste. In Iran during recent years accommodate necessity clean energy in the energy mix of the country, is taken into consideration. But The risk appetite from investors Compared to the high cost of primary and The uncertainty of future investment return (Because of new technology), on The other hand The Ambiguity of people's welcoming of this technology and perhaps defeat in the first round, Brought down risk appetite for investors. However, according to experts in this field, all electricity needs in Iran supply through solar energy. While unused capacity in the country is such that, electricity production in Iran, including the establishment and maintenance of power plants and power generation, Tens of billions of dollars fuel and destroys the country's foreign exchange earnings in annual. There are huge oil and gas resources and cheap energy prices through subsidies keep in Iran, caused our country left behind in the advanced industrial nations of new energies. [15]

3.1. Energy situation in Iran
In most countries we have thermal regulations that enable us to control building’s energy consumption. We also dispose of efficient techniques adapted to climate and to architectural culture. Building’s envelopes are designed to better insulate indoor climate from outdoor one by controlling heat and mass transfers between them. Though, this practices omit to consider the indirect effect that envelopes have on building’s energy consumption. Indeed, the radiative characteristics of the buildings envelop and geometrical arrangement of them in the city play an important role in the urban heat. this one modifies building’s energy consumption, because of the increase of air and surface’s temperatures, besides it leads to uncomfortable and unhealthy situations for inhabitants in summer. [16] Iran is among the countries that have abundant energy resources. Iran since 1913 has always been considered one of the major oil exporter. This country located between two source of energy in the world (the Caspian Sea and the Persian Gulf). This country in terms of the international situation is put in special circumstances. Iran by having 137.6 billion barrels of oil allocated 10.3% of global oil reserves. In the field of natural gas, with 29.61 trillion cubic meters, 15.8% of world gas reserves, is in the first place in the Middle East and second place of the world. Energies of oil and gas in Iran have the highest share in energy consumption. In the images 7 and 8
visible the share of renewable energy in the electricity production in the country and the status of renewable energy in the world. In 2010, approximately 1.48 percent of total electricity production comes from renewable energy. This value is much lower than amount of global (19 percent) [16]. Among renewable energy, the share of hydropower in the country is 1.45 percent more than other renewable energy. About the necessity of using renewable energy in Iran pointed to two cases. Oil consumption in Iran increased by a constant angle, but production has considerable fluctuations. Energy crisis is "of ice" in Iran. (image number) in the next few years will collide two charts and country instead of oil-producing will become a country consumer. (Iran Energy Balance Sheet, 2007) in this case the country in a state of limbo placed in the energy production and there is no return way. The only remedy for this situation is critical in the the use of renewable energy is in the long-term planning. According to the International Energy Agency in the 2012 Iran paid 82 billion government subsidy. The amount of subsidies paid by one-tenth of the total subsidy in the world. According to the statistics of the world's the largest donor subsidies for fossil fuel consumption. Even if half of this amount of money spent on setup and deployment of renewable energy systems, in the near future we can reduce pollution and preserve the national capital. This support, unlike the renewable is gradually dying out and the return on investment will be used to control in a short time [17].(Fig.7-8)

![Figure 7. Graph of share of renewable sources in the electricity production in Iran in 2010 [18]](image)

In the Figure 9, We can see Graph of oil production and consumption in Iran Oil consumption in Iran increased by a constant angle, but production has considerable fluctuations. Energy crisis is "of ice" in Iran. In the next few years will collide two charts and country instead of oil-producing will become a country consumer. Therefore, due to excessive consumption of energy in the country, needs to formulate a program for the use of other energy sources in the country [19]. Every living organism absorbs solar
energy and keeps your storage as called biomass. Each year, through photosynthesis, the equivalent of several times the world's annual consumption of energy, solar energy saved in leaves, trunks and branches of trees [19]. Therefore, the biomass of renewable energy sources is unique to store solar energy. Today's world is the world of development, at the same time, a growing world progress and development in various fields and in the meantime created the proper disposal of solid waste and energy from waste plants is also considered one of the development. In recent years, especially electric energy production from waste has been considered and the law also provided programs and support for it has been on the agenda [19]. (Fig.9-10)

Figure 9. Graph of polymer production and consumption of petroleum products in Iran [18]

Figure 10. Hybrid Strategies Chart for High-Performance Buildings [Source: Writer]
4. Conclusion
The first step in designing is detailed understanding of climate energy architecture, in order to identify a suitable climate. In an energy efficient design, we should examine different parameters affecting the climate, the building behavior, including behavior and thermal analysis. This parameters and tools are likely together and complement each other by factors such as thermal comfort. Some of these tools, such as: Psychometrics and environmental charts, graphs radiation - Ghosting can play an important role. In the developing countries such as: Iran uses one-dimensional strategies to reduce energy consumption is not responsive according to the specific circumstances of the country and on the other hand, there are problems in various fields (pollution and reducing sources of energy). To achieve the objectives of reducing energy consumption in residential buildings in the order to reduce the use of non-renewable energy sources and Annihilation of their emissions, we need to determine the strategy in two main sections, including preparatory measures and actions are final. These parts, including the mid-term strategies and directives to improve and facilitate the path. The initial or introductory sector includes measures of social, political, economic, organizations, and agencies of the government. This includes strategies such as, informing the people and culture of the use of heating and cooling systems and select the building based on energy standards. Another important factor in the introductory section is financial support and policy relevant organs of the goals and timing. In the second part with respect to the substrate examined practical actions and strategies and the quality of project objectives. For example, select the type of renewable energy systems according to their use and the combination of factors will have an impact system. In summary, in the developing countries does not work one-dimensional action in the field of energy efficiency and use of renewable energy systems. This cannot be achieved unless, by combining and using a combination of several systems and long-term strategies of the basic and fundamental and practical steps.

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