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Urban Commercial Green Walls and Their Role in Reducing Environmental Impacts and Energy Consumption of Cities

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Abstract

Increasing demand for energy and its consumption and environmental changes that were the product of the Industrial Revolution, especially in the second half of the 19th century, created an energy challenge for all countries, as the fossil fuel consumption has been accelerated around the world. The objective of the present paper is to present an appropriate solution for the current trend of the energy crisis, considering its status and based on a review of energy production and consumption statistics and the conditions in the world and the consequences of its consumption. According to valid statistics in the world, the architecture and urban development sector accounts for about 40% of the world's energy consumption and it has a high share in the production of greenhouse gas. The results of the paper suggest that the use of commercial green walls reduces energy consumption in buildings and it is an effective step in the development of agricultural products as a new technology and a green revolution in production of agricultural crops in the building industry, which plays a key role in reducing environmental pollution, especially in industrial cities.

Keywords: Agricultural Crops, Commercial Green Wall, Environmental Crisis, Revolution.

Introduction

The use of the green wall in the building and urban facades plays a major role in agricultural marketing and trade and business development in the agricultural industry, especially in the populated and industrialized countries of the world. This technology establishes a relationship between the city and natural elements and plays a major role in the clearing of polluted air and producing oxygen, which is critical to the vitality and health of its citizens. For this reason, the agricultural industry covers a part of the environmental disasters, while interacting with the machinery industry.

Green wall

A green wall or living wall refers to a wall that is covered by an independent structure or a part of the building covered with vegetation. The green wall is covered with vegetation and is in the form of living walls, bio walls, and vertical gardens and it is installed based on internal or external conditions of the building and covered with vegetation. In addition to the facade of the walls, these walls are defined as the green roof in the roofs.
The irrigation system of most of the green walls includes a frame, cells and irrigation channels. Its role is the creation of green space within crowded cities and it is

considered as a part of urban beauty. It is displayed vertically and as a large set of vegetation.

The walls of a building (Figure 1) in the bed of lasting beauty create an urban identity in the public minds.

Figure 1. Creating a beautiful bed in urban walls (http://bagheamoodi.com)

History of the green wall

Integrating architecture with nature and plants is not a new idea and natural landscapes have been mixed with urban buildings since early times. The designed green spaces also emerged with the formation of human concerns about architecture. The inclined walls of Ziggurat Nanna, built five years before Christ, were covered with trees and shrubs. Legendary *hanging gardens* of Babylon, which include the roofs of magnificent gardens and stair gardens, are the first known examples of green roofs and walls built between the 8th and 10th centuries BC (Syadati & Shoaei, 2018).

Types of green walls

There are several methods to build a green wall, the most common of which include the modular method, cable method, and hydroponic method

The role of the green wall in reducing energy consumption and controlling greenhouse gas emissions

The fast growth of industry and the production of new technologies influenced by the conditions of the times and the development of products in accordance to today's human demand, and the need for energy production and consumption have created the conditions for increasingly plunder of the energy sources in the world and environmental developments are a part of the consequences of energy consumption with fossil sources. The life of today's world

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depends on the existence and continuity of energy, indicating the important role of energy and the strong dependence of life on energy production and consumption in today's industrial world.

Undoubtedly, the importance of energy and the need for access to it have resulted in the development of technologies and the expansion of industries. Communities needed more fossil fuels to generate energy in the past. Nowadays, without energy, life on the planet becomes very difficult and almost impossible. Also, with increasing population growth around the world, the role and position of energies in today's world have greatly increased, indicating the increasing importance and necessity of access to energy supplies in the future.

Global consumption of energy and its consequences

The share of world energy sources from 1990 to 2018 and its projection by 2040 have been illustrated in (Figure 2). This figure illustrates the process of changing the sources of energy consumption and switching to bio-friendly sources.

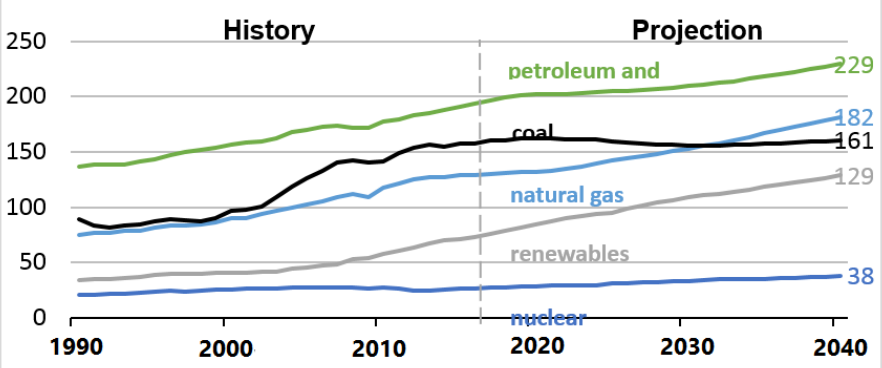

Figure 2. Share of sources of energy consumption separately (EIA, 2018)

End-use energy consumption in different parts of the world

Energy is generally consumed in different sectors as needed. Population growth and the need for development in each sector display a picture of the future of energy consumption. (Figure 3) illustrates the energy consumption in various sectors from 2010 to 2018 and projection of its consumption trend by 2050 based on BTU and sources of its consumption.

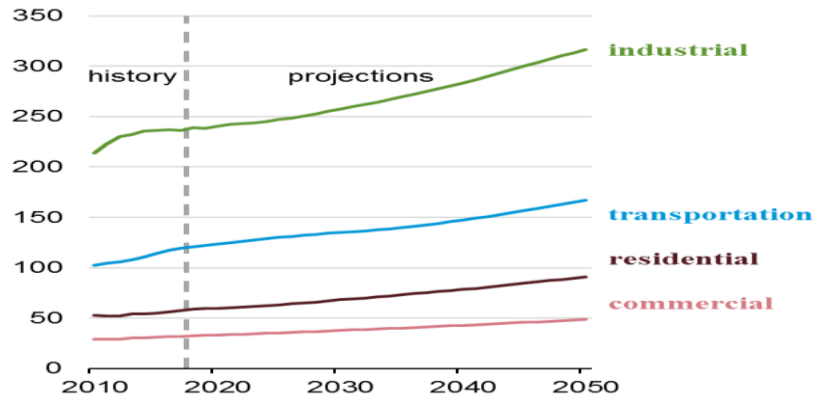

Figure 3. End-use energy consumption in different sectors (U. S. Energy Information Administration, 2018)

Vision of energy demand in architecture

Statistics show that the building is one of the largest energy-consuming sectors in the world. Buildings, as one of the most energy-consuming sectors in cities, account for approximately 40% of the world's annual energy consumption. The share of energy consumption varies in different countries due to their different characteristics. In the UK, for example, more than half of all energy is consumed in buildings. The share of energy consumption in buildings in the other EU countries and the US is 41% and 36%, respectively (Steamers, 2003).

6.3. End-use energy consumption separately for sources in the world

Humans realized the importance and role of oil by discovering it and developed several methods to exploit it based on their needs and applicability its sources. The speed of exploitation from its sources increased significantly due to the increasing need for it. In the Figure (4) illustrates the end-use energy consumption based on available sources of energy from 2010 to 2018 and projections of using it by 2050 (based on quadrillion British thermal units).

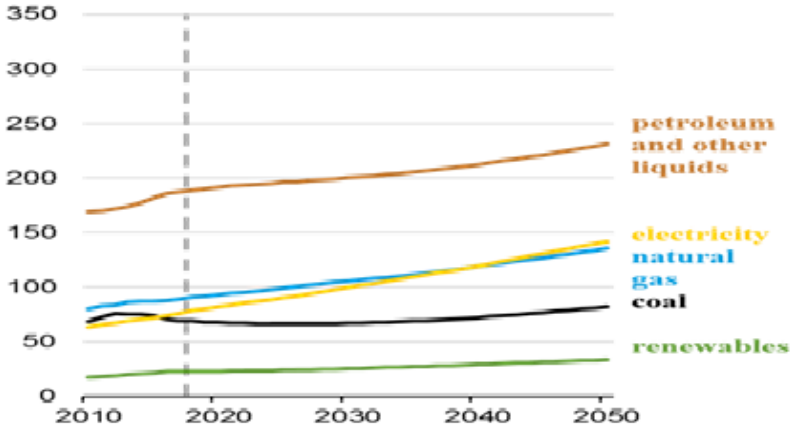

Figure 4. End-Use energy consumption separately based on sources (U. S. Energy Information Administration, 2018)

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The world is becoming more polluted and it causes more harm to living creators. (Figure 3) illustrates the total CO^2 emissions from energy consumption. In 2012, approximately 32723 million metric tons of CO2 were produced (International Energy Agency, 2014; Salman pour, 2019). Nowadays, energy is one of the basic needs of human life, and human dependence on fossil fuels has become much greater than past so that more 90% of the worlds' consumed energy is supplied from fossil fuel (Akbari Motlagh & Hejazi, 2011).

Using green walls: The use of green walls in two aspects is more important than other aspects.

Creating beauty in architectural and urban views

The great impact of the green wall in terms of creating urban beauty on the architectural walls (Figure 5) indicates the need to pay attention to this issue to increase the vitality of people, especially in industrial cities.

Figure 5. Urban beautification with a green wall (http://bagheamoodi.com)

Environmental capabilities and advantages in reducing the environmental pollution

Urban development and machinery life in cities have increased environmental pollution. It has resulted in an increase in greenhouse gas emissions in industrial cities. Also, suspended acids in urban air have increased the pollution of cities. The use of green walls and developing the culture of using the green walls result in the absorption of toxic and greenhouse gases by the leaves and it will reduce pollution in the city. In the Figure (6) illustrates the use of green walls reinforced with thick trees. It indicates the importance of this issue and its implementation technology.

Figure 6. Urban beautiful view of Agora Garden Tower in Taiwan (https://rayamag.com)

Creating new job opportunities with this new technology is one of the other social benefits of green walls. Recently, urban farming and the cultivation of vegetables in parts of the green wall have become popular. The urban farming has a great social and economic benefit for citizens. They also can absorb noise and reduce noise pollution inside the building (Rahim Meshkin & Khosravimehr, 2011). Energy consumption accounts for the largest share of greenhouse gas emissions in the world. However, economic growth and development require energy consumption. The ecosystem has been highly polluted due to greenhouse gas emissions and different pollutants caused by the burning of fossil fuels that are used commonly to meet the world's energy demand (Halmann & Steinberg, 1998). According to the International Energy Agency, greenhouse gas emissions caused by fossil fuels are on the rise, leading to global warming. In the Figure (7) illustrates the status of greenhouse gases emission over an 18-year period from 2000 to 2017. In general, this figure shows an increasing trend in greenhouse gases emission in the world, but the rate of its growth has declined from 2015 to 2017.

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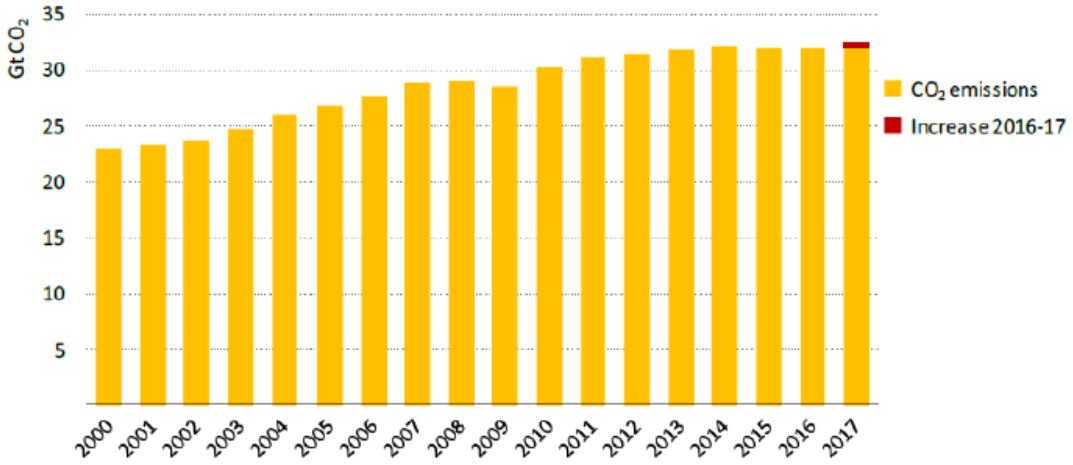

Figure 7. Greenhouse gases emissions status over an 18-year period: reference (IEA, 2018)

CO2 emissions in architecture

With the increasing demand for energy in the building sector and the use of fossil energy sources (Figure 6), CO2 emissions have increased dramatically and although the world shows an increasing trend for the use of renewable energy, there is a warning for the global community on increasing environmental pollution in architecture. At the present time, approximately 40% of the world's energy is used to generate electricity. This energy consumption to generate electricity accounts for 40% of greenhouse gas emissions, especially CO2 emissions caused by fossil energy consumption in the electricity sector (IEA, 2014). Iran's efforts to achieve economic growth and development on the one hand and low level of environmental awareness and the lack of proper pollution control rules, on the other hand, have made policymakers and researchers in this field pay attention to environmental pollution issues and factors affecting it in recent years many studies should have been done in this field (Salman pour, 2019).

Using plants as one of the constituents of the environment has a significant environmental impact on densely populated areas, such as:

1. Improving the performance of the building's façade in terms of temperature
2. Lowering the temperature of indoor spaces and increasing air quality due to the absorption of carbon dioxide.
3. Physical barrier against air currents and rains
4. Increasing per capita and diversity of plant species
5. Green facades can rely on the buildings' facades, fences, and columns or they can be established independently. The structure of the green facades scaffold can be made of different materials such as wood, metal, lattice, cable, etc (Syadati & Shoaei, 2018).

Reducing energy consumption with the green wall

Green walls in addition to giving beauty for urban environments can act as a suitable insulator in adjusting the indoor temperature of the building. These green walls increase the wind flow and thus cool the city temperatures and improve thermal comfort conditions and accordingly play an important role in reducing energy consumption, especially in hot seasons. This dynamic system improves indoor energy efficiency by preventing direct sunlight in summer and reducing and controlling the effect of winter wind. The use of green walls as thermal insulation produced between green walls and walls of the building and evaporative cooling by evaporation phenomenon is a way to reduce the energy consumption of buildings.

Conclusion

Covering the facade of the building with vegetation is environmentally important as it improves the quality of the environment and enhances the quality of life, and accordingly, plays a major role in reducing air pollution, reducing greenhouse gases, reducing environment temperature especially in crowded and industrialized countries. Green wall technology plays a vital role in the production and development of agricultural crops, especially in densely populated cities. It also plays a crucial role in the production of oxygen and purifying air and reducing urban pollution, moderating urban heat island phenomenon and increasing the mental health of citizens, reducing the cost of building maintenance and cutting the air conditioning costs. Using advanced technology to develop its industry, this agricultural crop as a product of the green revolution and the newly developed technology of agricultural and horticultural science, that is called Green Industrial Revolution, plays a major role in reducing future energy consumption and improving the environmental performance and increasing the beauty of architecture and urban development in the world.

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