Proceedings World Geothermal Congress 2020+1
Reykjavik, Iceland, April - October 2021

Mechanisms for Activating Applications of Geothermal Energy in Achieving Sustainable Development

Ramzi Hazza Abdullah Murshed

Ministry of Electricity and Energy. Republic of Yemen

E-mail address: ramzykoradh@gmail.com

Keywords: Renewable Energy, Geothermal, Sustainable Development

ABSTRACT

The issue of the use of new and renewable energy, especially Geothermal Energy, has emerged on the world stage as a strategic resource to meet the future needs of local and global energy. It is clear that there is a strong link between the success of development and the energy available as the main engine. As a very important dimension, coinciding with the depletion of traditional sources of energy over the next 30 years, another issue related to the contribution of the energy saving process is based on the traditional sources – including the steady rise in the rates of global pollution, especially the energy-intensive urban centers. Therefore, this research seeks to identify the appropriate mechanisms to activate the systems of the use of thermal energy from the underground in our country and our communities to achieve and activate the principles of sustainability in the development process, the most important of which: research and development, partnership and funding, awareness and motivation, legislation and law, inclusion in the development plans of the regions and urban communities.

1.INTRODUCTION

The issue of the use of new and renewable energy, especially geothermal energy, has emerged as a strategic choice to meet the local and global energy needs. It is clear that there is a strong correlation between the success of development and the energy available as the main engine, as reflected in the beginning of depletion of traditional sources of energy over the next thirty years. In addition to other issues related to the contribution of the energy saving process based on traditional sources is the rise in global pollution rates, especially energy-intensive urban centers. Therefore, this research seeks to identify appropriate mechanisms to activate the thermal energy systems from the underground in our country and our communities to achieve and activate the principles of sustainability in the development process, and the preservation of the environment and its resources.

2. METHODOLOGICAL FRAMEWORK

2.1 RESEARCH OBJECTIVES

The aim of the research is to try to advance efforts towards the implementation of a strategy for the sustainable development of urban communities, especially the major ones, which, in their multiple axes, rely on the new energy generated from the ground as a means to reduce the negative environmental impacts of increasing urban development and sustainability.

In addition, the research aims to focus on the issue of energy savings from geothermal use as a source of clean energy in Yemen, the Arab world, and worldwide in order to obtain a clean environment for sustainable development

2.2 METHODOLOGY OF RESEARCH

In view of the close correlation between environmental pressures and high pollution rates on the one hand, and increasing urban development, on the other hand, the research adopts a set of mechanisms to reduce the negative effects of increasing urbanization on the environment by using renewable energy sources, especially from geothermal energy at all levels through:

• Monitoring the effects of conventional energy use on the steadily increasing rates of pollution in urban centers based on several experiments.

• Draw the most positive effects of using this technology in protecting the environment and achieving the principles of sustainability.

• Identify the appropriate mechanisms to activate the systems for the use of geothermal energy applications and access to sustainable cities.

• Review of the most important experiments in the application of geothermal energy technologies (Geothermal) And its effects on pollution reduction.

3. BASIC CONCEPTS

3.1 Renewable Energy

Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and Geothermal heat.

3.2 Geothermal

Geothermal energy is the direct generation of energy from Earth. The word geothermal comes from the Greek words geo, meaning earth and thermal, meaning heat. They are the heat of the earth and are used to translate the geothermal temperature of this world.

The geothermal energy begins from underground rocks that heat the outer crust of the Earth. The rising heat of these molten rocks heated the underground water pools called geothermal reservoirs.

3.3 Sustainable Development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

4. MAIN ISSUES OF RESEARCH :

The main issues that will be addressed in the research are:

* New and renewable energy is a global demand for sustainability.

* Different levels of energy technologies use underground geothermal development.

* Clean development prospects for Yemen and the Middle East region.

* The positive effects of energy saving from underground and its impact on the environment in urban areas

* Mechanisms for including energy uses in urban development.

The following research discusses these issues down to a set of results that enable the realization of a Sustainable development model.

4.1 New and renewable energy is a global demand for sustainability.

It is important to raise global interest in the environment and its sustainability now, using sustainable clean energy sources (such as wind, sunlight, bioenergy, hydropower, etc.). This is a strategic option to provide future energy development needs, especially with many challenges, including: the depletion of conventional energy sources (coal, oil and gas). It is expected that by 2030, the risks resulting from the exploitation of nuclear energy, as well as the increasing rise in the rates of pollution due to greenhouse gases exceeding global limits, and their relationship to climate changes resulting from global warming, will undermine the main reasons for the use of traditional sources such as oil and gas, since they contribute about 26% to emissions.

Figure (1) Advance all other sources of greenhouse gas emissions

As a result, the current global attention to renewable energy has been linked to strategic objectives:

1-To provide economically safe and sustainable energy for the principles of sustainability.

2-To stabilize the climate and reduce pollution.

3 -Reduce conventional fuel consumption (coal, oil and gas) and maintain it as a strategic resource for a longer period.

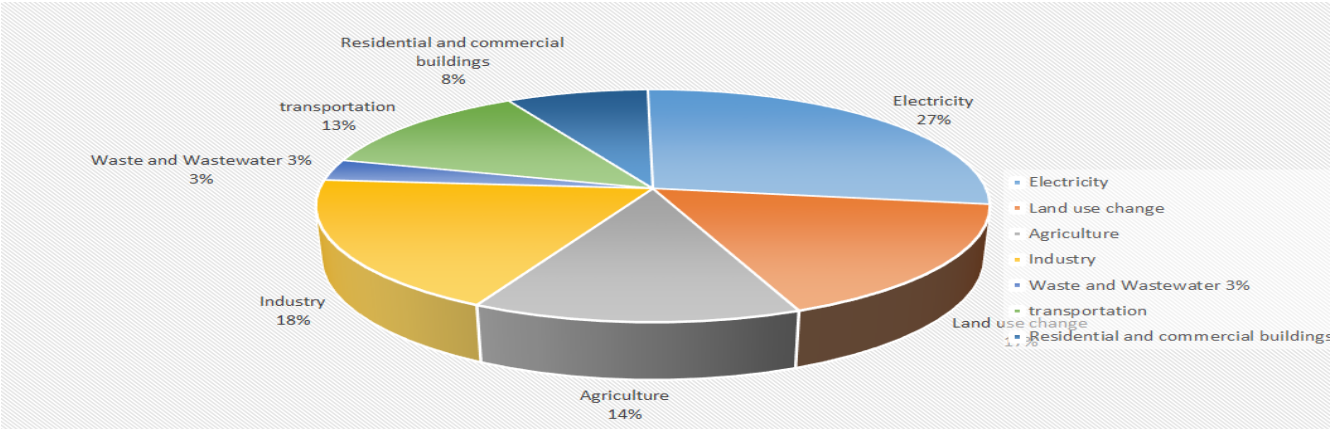

Figure (1) Relative distribution of carbon dioxide equivalent emissions sources globally

In view of the importance of the issue and its impact on global levels, the studies and research have been numerous. IPCC recommended that global emissions of carbon dioxide should be reduced by about 30% by the middle of this century, so that atmospheric concentration can be stabilized at 450 ppm The study estimated that following current energy policies in the EU, the Middle East and North Africa will continue increasing CO2 emissions from 770 million tons / year in 2008 to about 2000 million tons per year in 2050. This will have serious consequences. Climate changes as the Earth is warming. The Intergovernmental Panel on Climate Change (IPCC) has identified the Copenhagen Summit as having seven serious consequences for the global environment:

1-- Drought and floods are increasing. When the weather is warmer, evaporation increases, whether from sea or land. This leads to drought in some areas where the increasing evaporation of precipitation and floods in other regions are not compensated.

2-Decreasing snow, where the icebergs are shrinking at present and ice is expected to melt very quickly, and areas dependent on meltwater from the mountains can face drought and lack of drinking water. According to the IPCC, one-sixth of the world's population lives in areas affected by this.

3-The increase of natural phenomena, causing the warmth of the weather in more waves, which may increase the intensity at sometimes and lead to storms at other times.

4-Sea level rise due to the melting of the icebergs, and the thermal expansion of the sea. As a result of the temperature rise of two degrees Celsius, sea level rise will be about one meter

5-Coastal cities sinking due to rising sea and ocean level.

6-Extinction of flora and fauna, due to a change in the ecosystem due to climate change.

7-The decline in agricultural production, and thus the reduction of food stocks, which threatens the world with a food crisis.

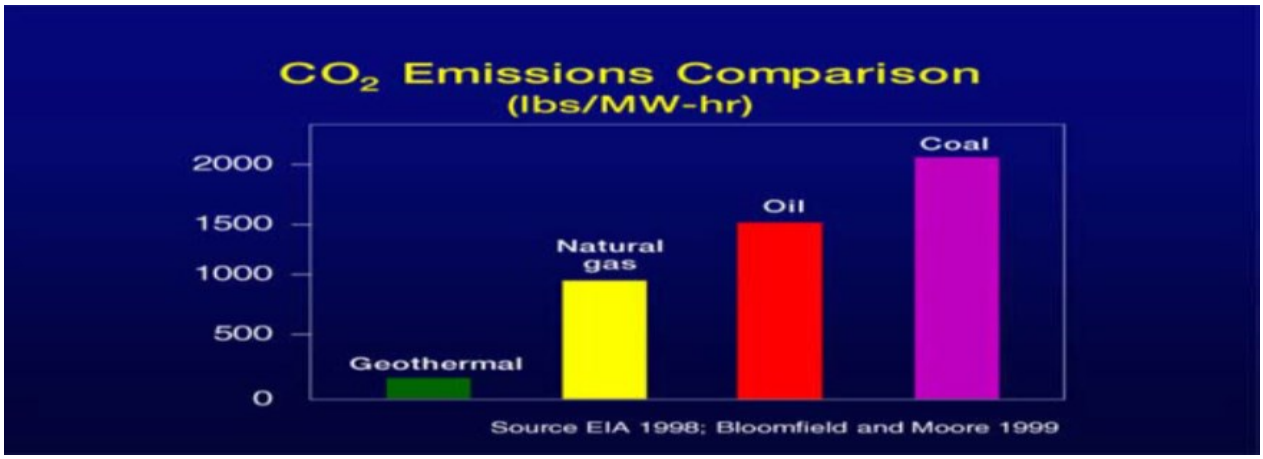

Table (2) refers to the percentage of CO2 emissions from energy use from the ground compared to other sources (EIA, 1998; Bloomfield and Moore, 1999)

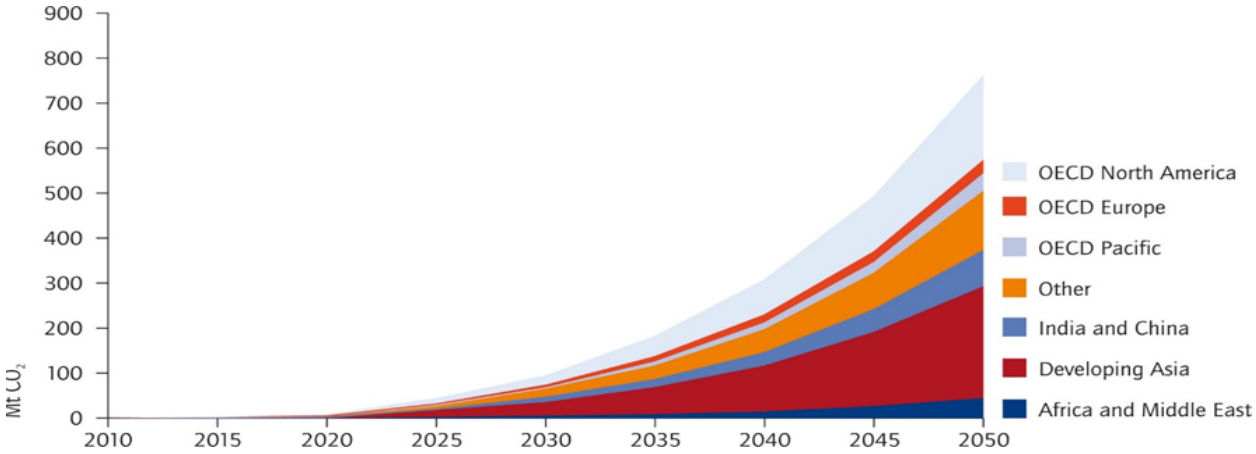

Figure (3) The projected scenario for the reduction of CO2 emissions of geothermal electricity by 2050 (IEA, 2011)

According to the report of the International Climate Commission (IPCC), whose focus is on "Renewable energies and climate change mitigation", the use of renewable energies, including geothermal energy, could contribute to reducing carbon dioxide emissions by about one-third by 2050. Estimates said that annual greenhouse gas emissions are currently estimated at more than 30 GHz globally and optimistic forecasts are that the proportion of renewable energies will reach 43 percent by 2030 and 77 percent by mid-century.

4.2 Economic dimensions of the trend towards saving existing energy from the ground

At present, the total global capacity is 10 GW, which is only a fraction of the full potential of the sector, and far less than hydropower, biomass energy and wind. The major factors limiting the growth of geothermal energy as a major source of renewable energy are the lack of technology and establishment expenses. The costs of setting up a plant from the Earth's heat are two to three times the cost of coal-fired power plants, ranging from three million to five million euros per megawatt.

Once geothermal enters the production stage the cost of producing energy from the Earth's temperature becomes competitive with fossil fuels at an average of five to eight cents per kWh. This makes geothermal energy particularly attractive to emerging economies, which must meet their growing energy needs with low carbon content. Geothermal energy represents the only actual primary load capacity alternative to fossil fuels. While solar and wind energy production is affected by changing weather patterns, terrestrial geothermal generation provides sustainable capacity at an average of 90 percent, compared to 25 percent with that of solar and wind power. It also outperforms the generating capacity of biomass and hydropower.

Another advantage is that geothermal energy can be used to generate electricity, along with heating and cooling. "Of the $ 132 billion invested in the renewable energy sector in 2007, only about $ 37 billion was spent on geothermal energy," says New Energy Finance.

However, this represents an increase of 183 percent compared to 2006 investment levels. Mark Taylor says, “this jump, coupled with the new production capacity currently under development, is very exciting.” Further, the NEF analyst says once the ongoing reforms of the UK energy bill come into force, geothermal energy will be eligible for renewable energy production subsidies per megawatt / hour of energy production. With the development of technology, the International Energy Agency (IEA) estimates that geothermal energy could make up two-thirds of the world's renewable energy base by 2050.

4.3 Building a system for the use of geothermal geothermal energy in sustainable development.



Figure (4) Thermal power generation systems from the ground(Northern Heat Pump, 2019)

4.3.1 Types of stations that generate electricity from geothermal energy

There are three main types of power stations that work on this technique:

Dry steam plants: This method is the oldest and most widespread method, the same method used in Italy in 1904. These stations use naturally occurring water in the deep ground layers under high pressure and heat. They are extracted by drilling deep wells and are released in the form of water vapor because of its high temperature and pressure difference. This steam runs through the tubes and then displays the For Tor Pinat spin generator that produces electricity. The condensate water is pumped to the ground through another well in the well of the injection well.

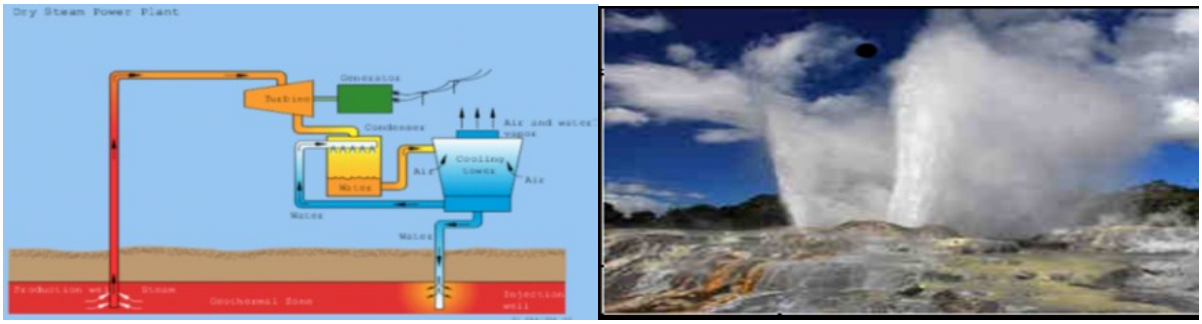

Figure (5): A diagram of the dry steam power plant and steam exploding from the depths of the earth (Mburu, 2010).

Flash steam plants: Water is pumped to the bottom layers to obtain steam. These stations use liquids under high pressure under the ground, where they are concentrated in a small hole vessel that leads to another vessel with moderate pressure. When the liquid moves from the first to the second vessel through the hole, High pressure. The steam drives the turbine and in turn drives generators that produce electricity. The remaining condensate water is pumped into the ground through injection wells.

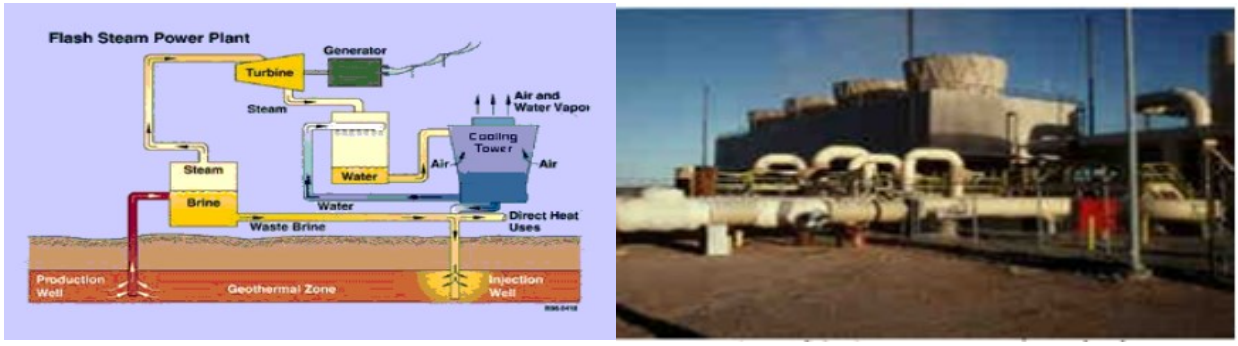

Figure (5): Schematic of a single flash steam power plant and factory works for flash steam in California (Mburu, 2010).

Binary cycle power plants : These stations use liquids with a high boiling point (about 200 ° C) that are pumped to the top where they heat the water with a normal boiling point (100 ° C) in another tube that runs along the hot tub. The water heated by the high temperature of the liquid evaporates in the other tube. The steam drives the turbine of the electric generator and condenses again to align the hot tub, moving in this way in a continuous rotation. Pumping water extracted back into the ground through injection wells.



Figure (6): Power station diagram of a two-cycle system and a visual example of a dual-cycle station (Mburu, 2010).

4.3.2 Direct uses of geothermal energy

Uses include hot mineral springs for bathing, cooking, and heating. Today many still use geothermal energy in the heating of buildings, such as those through Reykjavik city heating systems in Iceland. Hot selling of showers, many people think that mineral-rich hot water enjoys natural healing powers. Industrial applications of geothermal energy include food drying, gold mining, and milk pasteurization. Drying of vegetables and fruits is the most common industrial use of geothermal energy.



Figure (7) Some of the direct use applications (Geo Heat Center, n.d.)

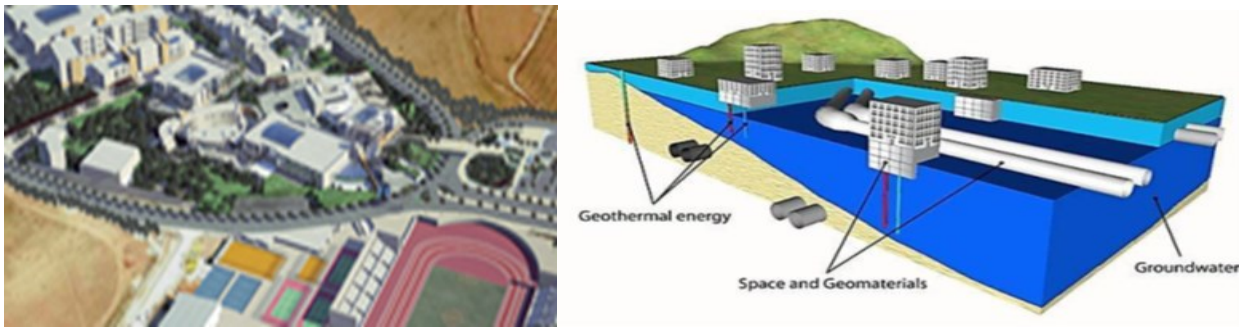

Figure (8) The American University of Madaba is the largest thermoelectric heating and cooling system in the MENA region, with a cooling load of 1.6MWs. It won the 2011 Energy Ball Award (http://www.moqqatel.co/openshar/Behoth/fenon""elam/sec25.do-cvt.htm)

Underground urbanization can be defined as an innovative concept of urban restructuring and the practice of transformative construction (Utudjian, 1972, Barles and Guillerme, 1995, Bellinger, 2007). Based in Switzerland since 2009 (Parriaux et al., 2010) so as to provide a Geothermal unit meeting the four pillars of urbanization under the context of sustainable development illustrated in Figure 8 above.

4.3.3 The stages of establishing the geothermal power project according to different periods

From the above, different geothermal power supply systems have been introduced in different stages.

Stages of these applications according to nature, which can be illustrated from figure (9)

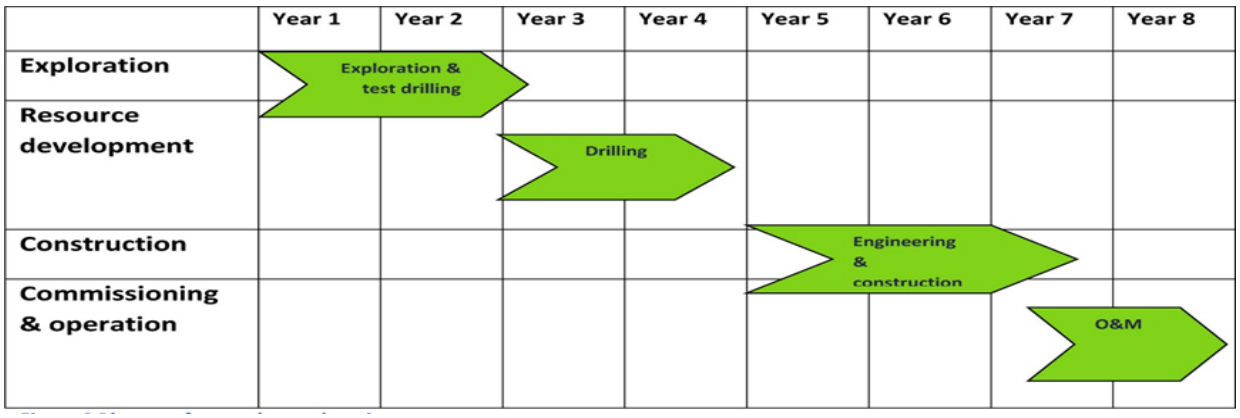

Figure (9) Stages of establishing a geothermal power project (Geoelec, n.d.)

The geothermal project can be divided into five main phases Exploration, resource development, construction, commissioning, operation and maintenance (Bosselmann, 2002).

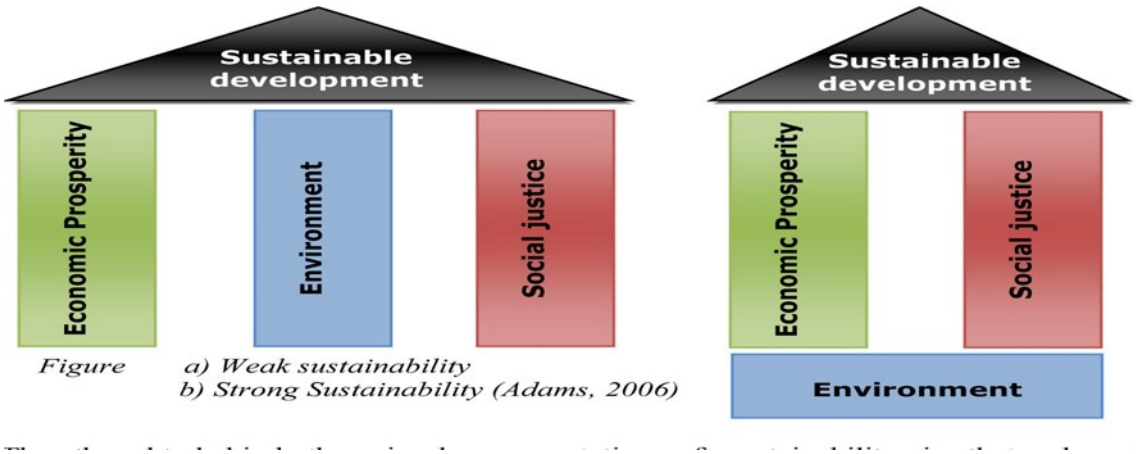

Figure (10) illustrates methods for assessing the sustainability of energy projects; (a) Poor Sustainability(b) Strong Sustainability (Adams, 2006)

4.3.4 Sustainable Community Building

The objectives of sustainable development are achieved by a genuine partnership that stems from a comprehensive community response to all stakeholders involved in building the Geothermal System. We refer here to the two development leaders: 1. civil society organizations. 2. Educational institutions and research and development centers 4. Energy companies 5. Governments 6. Funding institutions.

If the real partnership between them is to take place and adopt and direct their efforts towards the use of clean energy as one of the main axes for creating a real sustainable development with good living conditions free of contaminants and waste of resources, this will lead to a sustainable development society, leading to an integrated clean development system.

5 - CLEAN DEVELOPMENT PROSPECTS FOR YEMEN AND THE MIDDLE EAST

Yemen and the Middle East are an attractive destination for the Clean Development Mechanism (CDM). They are rich in renewable energy resources and have a strong oil and gas economy. It is curious that there are very few clean development mechanism (CDM) projects taking place in the countries of the region, with only 23 clean development mechanism projects recorded so far. The region accounts for only 1.5 percent of the CDM projects globally and only 2 percent of the CERs.

The two main challenges facing many projects are weak capacity of most countries in the region to identify, develop and implement projects, and secure core funding. Currently, there are many CDM projects in progress in Egypt, Jordan, Qatar, Morocco, United Arab Emirates and Tunisia. Many companies have begun to explore this rapidly evolving field.

6 POSITIVE EFFECTS OF ENERGY SAVING FROM UNDERGROUND AND ITS IMPACT ON THE ENVIRONMENT IN URBAN CENTERS

6.1 The most important advantages of this energy:

* It is a clean energy that is not harmful to the environment and does not cause any pollution either in extraction, conversion or use.

*It is in large quantities and in vast areas and for most countries of the world.

*The low energy production costs after initial costs of plant production, which can be prohibitive, result in a high yield of extracted energy.

6.2 Impact on the environment

Ground-derived liquids contain a mixture of gases, including carbon dioxide, sulfur sulphide (H2S), methane and ammonia. These gases are involved in the problem of global warming and acid rain. The amount of CO2 generated by geothermal plants is about 122 kg per 1 megawatt of electricity, a fraction of what fossil fuel plants produce. This is why power stations that produce large quantities of these gases that cause acid rain are supplied with units to control and separate these gases to reduce their negative effects on the environment. In addition to dissolved gases, hot water extracted from the depths of the earth may contain soluble salts and toxic substances such as mercury or arsenic. These chemicals are deposited when the water is cooled and may cause environmental damage if burned on the ground. The policy of reusing hot water and pumping it deep into the earth is one of the factors that reduce the negative impact on the environment when it is exploited. The energy of underground heat is certainly the safest of all. It is characterized by the fact that it does not produce solid or gaseous pollutants. Except for the deposition of sulphide sulphides in pipes, which requires routine and periodic maintenance. The heat of the subsoil is an inexhaustible supply of energy that can make the human environment more pure, and also contribute a stable supply.

7 - SEARCH RESULTS

Geothermal Energy Strategy in Yemen and Geothermal Energy Utilization Mechanisms in Sustainable Development.

Yemen and the Arab world are characterized by the fact that God has loved it abundantly in energy. Geothermal is one of the most important sources of energy that will change the map of the region's production pattern, in not more than thirty years. Throughout the region is a large supply of heat from the ground. This resource extends through our country, Yemen, in particular, and the Arab world in general. Therefore, ignoring this resource, which will be pursued by the global energy markets, especially the European Union, in formulating the strategic axes of sustainable development at the national, regional and local levels will lead to the loss of these strategies of credibility and effectiveness.

According to the report, the research has come up with a set of mechanisms that provide a model for including energy use in sustainable development, as follows:

* Legislation and law: There must be a legislative and legal framework for the process of saving energy through geothermal utilization.

*Partnership and funding: Yemen and the Arab world have the resource so it is necessary to speed coordination between Yemen and the Arab nations within the framework of a unified agreement that supports the position of these countries in negotiating with European governments and global investors in this field.

*Stimulation, and encouragement: Stimulate the production of electricity generated from renewable energy sources. The private sector needs to invest in sustainable renewable energy.

*Planning and Development: The government agencies concerned with development and planning should seek to include the system of using new and renewable energy, especially underground, in the development plans of the regions and cities at all levels.

REFERENCES

Atkin Donald, Hisham Mahmawi, "Transition to the Future of Renewable Energy", International Solar Organization, 2005 Economic and Social Survey for Western Asia, ESCWA, 2001

Our Common Future, World Commission on Environment and Development, translated by Mohammed Kamel Aref, World of Knowledge Series, Kuwait, 1989, p. 83.

Development Report and Climate Change, World Bank, Al Ahram Center for Publishing, Translation and Distribution, 201 IPCC: Report of the International Climate Commission

Intergovernmental Panel on Climate Change IPCC، http://www.ipcc.ch/publications_and_data

Geothermal Programmatic Environmental Impact Statement www.blm.gov/pgdata/.../scoping_pp

Technology Roadmap Geothermal Heat and Power www.iea.org

Dr.. Saud Yousef Ayash (1978) Alternative Energy Technology The series was published in January 1978 under the supervision of Ahmed Mishary Al-Adwani 1923 1990 Chapter V Geothermal energy

Author Dr. Mustafa Mounir Mahmoud Mechanisms for activating applications of solar energy in the development of sustainable urban development "Faculty of Regional and Urban Planning, Cairo University, Egypt

GeoElec Consortium - November (2013) Final Project Report- GeoElec Project Deliverable 6.2- GEOELEC project: www.geoelec.eu

http://www.alarabiya.net/ar/aswaq/2014/04/14(2)

Martha Mburu Geothermal Development organized by UNU-GTP, GDC and KenGen, at Lake Bogoria and Lake Naivasha, Kenya, Oct. 29 – Nov . 19, 2010.nt Company

Li, H., A. Parriaux, et al. (2011). The way to plan a viable Deep City: from economic and institutional aspects

Authors: GeoElec Consortium GeoElec Project Deliverable 6.2- November 2013

Sustainability evaluation of geothermal-systems in Iceland-Indicators for sustainable production- REYST report 09-2010

Bruce D. Green and R. Gerald Nix, National Renewable Energy Laboratory Geothermal— the Energy under Our Feet NREL/TP-840-40665 November 2006

Murshed

An Integrated Strategy for Sustainable Underground Urbanization THÈSE NO 5869 (2013)

REYKJAVÍK (2010) Energy Graduated school OF Sustainable Systems Report REYST 09-2010

Underground urbanization can be defined as an innovative concept of urban restructuring and the practice of transformative construction (Utudjian, 1972, Barles and Guillerme, 1995, Bellinger, 2007). Based in Switzerland since 2009 (Parriaux et al., 2010) so Geothermal unit of the four pillars of urbanization under the urban context of sustainable urban development illustrated