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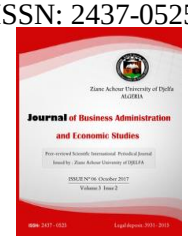

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The Importance of Improving Energy Efficiency in Residential Buildings in the Countries of the Middle East and North Africa, with Reference to the Case of Algeria

أهمية تحسين كفاءة الطاقة في المباني السكنية في دول الشرق الأوسط وشمال إفريقيا مع الاشارة الى حالة الجزائر

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Abstract

The aim of this paper is to highlight the importance of energy efficiency in the residential sector in the Middle East and North Africa, especially as this sector is one of the largest sectors in energy consumption.

It has been shown that energy efficiency is weak in many countries of the region compared to developed countries. Although most of them adopt programs and objectives of improving energy efficiency in the residential sector, their potential to save energy from these programs is greater than the results achieved.

To achieve this success, it must adopt an integrated and coherent package of programs, policies and mechanisms to improve energy efficiency, guarantee its success by providing a strong legislative and institutional environment, provide the necessary funding, benefit from the experiences of the leading countries, and the gradual reform of energy subsidies, To achieve the desired goal, without neglecting the side of building consumer awareness of the need to provide energy to ensure the right of future generations.

Keywords

Energy Efficiency ; Residential buildings; Energy Intensity ; Building Standards ;

JEL Classification Codes : O44 ; Q38 ; Q47 ; Q48 ; Q58 ;L74.

الملخص

تهدف هذه الورقة البحثية إلى تسليط الضوء على مدى أهمية كفاءة الطاقة في القطاع السكني في دول الشرق الأوسط وشمال إفريقيا، خصوصا وأن القطاع السكني يعتبر من أكبر القطاعات تسببا في إستهلاك الطاقة.

وقد تبين فيها أن كفاءة الطاقة تعتبر ضعيفة في العديد من دول المنطقة مقارنة بالدول المتقدمة، ورغم تبني أكثرها لبرامج وأهداف تحسين كفاءة الطاقة في القطاع السكني إلا أن إمكانياتها في توفير الطاقة من تلك البرامج أكبر من النتائج المحققة.

ولنجاح هذا التوجه ينبغي عليها إتخاذ حزمة متكاملة ومترابطة من البرامج والسياسات والآليات الصارمة لتحسين كفاءة الطاقة، والمرهون نجاحها بتوفر بيئة تشريعية ومؤسسية قوية، وتوفير التمويل اللازم لذلك، والإستفادة من تجارب الدول الرائدة، مع ضرورة الإصلاح التدريجي لدعم أسعار الطاقة الذي يعتبر أكبر معيق في وجه تحقيق الهدف المنشود، ودون إهمال جانب بناء الوعي لدى المستهلك بضرورة توفير الطاقة لضمان حق الأجيال القادمة فيها.

الكلمات المفتاحية

كفاءة الطاقة ؛المباني السكنية؛ كثافة الطاقة ؛ معايير البناء.

تصنيف JEL: O44 ; Q38 ; Q47 ; Q48 ; Q58 ; L74

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I. INTRODUCTION:

The energy sector plays a crucial role in the development of many economies of the Middle East and North Africa (MENA), but the current patterns of energy consumption make these countries among the least efficient compared to many countries in the world, as they rely heavily on depleted fossil energy sources, and the demand rate On energy increases in many of them then the annual growth rate in GDP, which means that the current trends in it are not sustainable, and with the increasing rate of population growth in these countries, this makes them face the challenge of achieving energy security, which is a priority issue that may affect even The National security of countries .

The strength of This risk increasing by the energy subsidy policy pursued by many countries in this region, which encourages improvidence and wasting in consumption, which threatens the success of energy efficiency investments.

because the residential sector is one of the most prominent energy-consuming sectors in in MENA region, investing in improving energy efficiency in this sector would achieve significant energy savings and achieve positive results in the course of sustaining the current energy model for it.

Based on these data, the main **problematic of this study** can be formulated by asking the following question:

How important are energy efficiency policies in the residential sector? What is the reality of the adoption of these policies in the countries of the Middle East and North Africa?

To answer to this problematic it'll putting the following **hypothese :** Improving energy efficiency in the housing sector in MENA countries is considerate one of the priorities of these countries in order to shift towards a sustainable energy pattern imposed by the current international economic transformations**.**

The importance of the study: This study derives its importance from the importance of preserving non-renewable energy resources for the future generations, as well as the importance of improving energy efficiency in various sectors, especially the residential sector, and facing the great development that many countries have reached in adopting programs and policies of improving energy efficiency and rationalizing its consumption**.**

Objectives of the study: This study aims to knowing the role of energy efficiency mechanisms and programs in economizing energy in countries, and then to knowing the real adopting of MENA's countries of that type of program in the housing sector because the large expansion of its share in terms of energy consumption compared to the rest Sectors, and the economic, social and environmental consequences of this adopting.

II. THEORETICAL FRAMEWORK AND PREVIOUS STUDIES:

1. The Theoretical framework

A. Identify And Define Variables Related To The Research

Energy Efficiency is defined as: " The measure that accounts for delivering more services for the same energy input, or the same amount of services for less energy input .Conceptually, this is the reduction of losses from the conversion of primary source fuels through final energy use, as well as other active or passive measures to reduce energy demand without diminishing the quality of energy services delivered". [1]

Energy Efficiency In Buildings Referring to UNEP, EPA and Wang ,is defined as "using less energy without compromising the performance of the building" while energy performance is defined as the quality of building towards energy consumption. [2]

Types of Energy In Buildings : it can be categorized into two types: (1) energy for the maintenance/servicing of a building during its useful life, and (2) energy capital that goes into production of a building (embodied energy) [3]

Energy Intensity of Gross Domestic : is the amount of units of energy used per unit of gross domestic product (GDP) (unit of economic output.[4]

Carbon Dioxide Intensity of Residential Sector: Carbon Dioxide Intensity is defined as "Ratio between the total CO2 emissions of the energy sector and the GDP at constant price. While CO2 intensity of residential sector Ratio between the total CO2 of the residential sector and value added of residential sector at constant prices .[5]

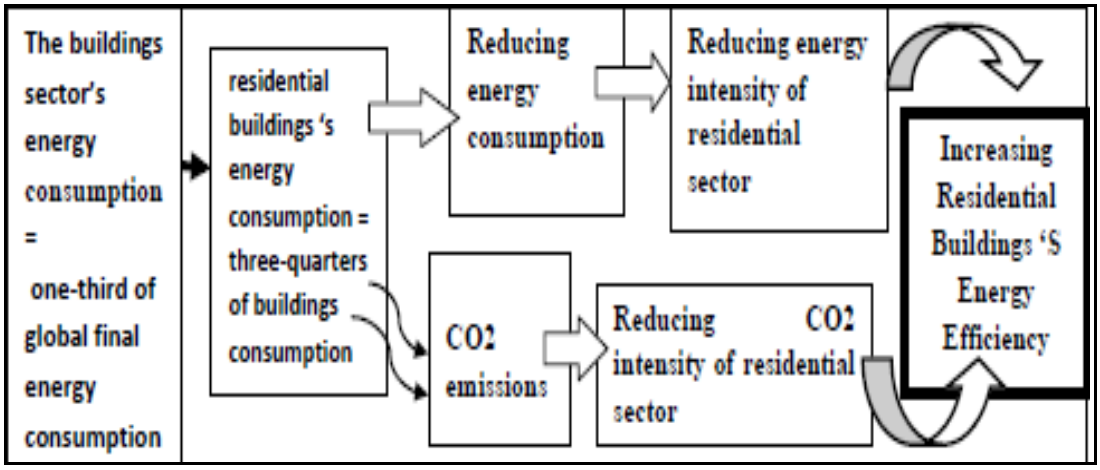
Determining The Nature And Direction Of The Relationship Between Different Variables

According to the Energy Information Agency, worldwide **energy consumption** is expected to increase 1.4% per year through 2035, implying that **buildings** will consume 296 quadrillion Btu by the year 2035,and because buildings are a large energy consumer, they are also a major contributor to global carbon emissions and greenhouse gas (GHG) production. [6]

The buildings sector accounts for nearly **one-third** of global final **energy consumption** globally and in the MENA region, including the use of traditional biomass. About **three-quarters** of this energy consumed by **residential buildings**.

Energy intensity typically is used as a proxy for **energy efficiency** in macro-level analyses due to the lack of an internationally agreed-upon high-level indicator for measuring energy efficiency.[7]the efficiency is inversely proportional to the value of the indicator, the small value means a height efficiency, which is meaning that less energy is consumed with a greater increase in GDP.

From the foregoing, it can illustrate the relations between different research's variables in following figure:



2. The previous studies

- Study of Arvind Chel a and Geetanjali Kaushik, **Renewable energy technologies for sustainable development of energy efficient building**, Alexandria Engineering Journal (2018) 57, this study tray to know how can achieve energy conservation through energy efficiency in the building by using the Renewable energy technologies, in conclusion the author affirmed that there is urgent need to develop policies all over the world for building integrated renewable energy systems. It concentrated about **Renewable energy technologies in buildings,** but this study concenters about the capability of improving energy efficiency in MENA and its positive effects without concentering at its approaches.
- Study of AmirHosein GhaffarianHoseini a,n and al. **Sustainable energy performances of green buildings: A review of current theories, implementations and challenges**. Renewable and Sustainable Energy Reviews 25 (2013), This study targets to elucidate the essence of sustainability in green building design implementations it draws attention to the sustainable energy performances of green buildings to identify the influential parameters based upon the contemporary successful accomplishments. It concluded that the contemplations of the research findings are recommended to be taken into consideration by architects, engineers and developers for the development of future eco-cities with an explicit viewpoint towards developing greener and smarter built environments.

  It concentrated about green building design implementations which cares the architects, engineers, so it has engineering dimension, but this study has economic dimension.
- Study of Giacomo Di Foggia, **Energy efficiency measures in buildings for achieving sustainable development goals**. Heliyon review, 4 (2018). This research cam to links energy-efficient building with sustainable development goals, it concluded that Energy-efficient building can be linked to SDG 11, aimed at "making cities and human settlements inclusive, safe, resilient and sustainable " and SDG 13 that calls for "urgent action to combat climate change and its impacts."

  It related with the impacts of achieving energy efficiency at the sustainable development, environmental, social and economic in the world with using method statistic to testing the hypotheses of the link between research's variables, but this study talk about these impacts MENA region without using the statistical method.

III. METHOD AND PROCEDURES:

This research it cares of the Middle East and North Africa (MENA region), which composites of 20 countries: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordon, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia Kingdom, Sudan, Syria, Tunisia, united Arabia Emirates And Yemen, so it's the population and sample of the study.

1. An overview of the reality of energy efficiency in the countries of the MENA region

To judge energy efficiency ,there are many indicators we will talk about two of them:

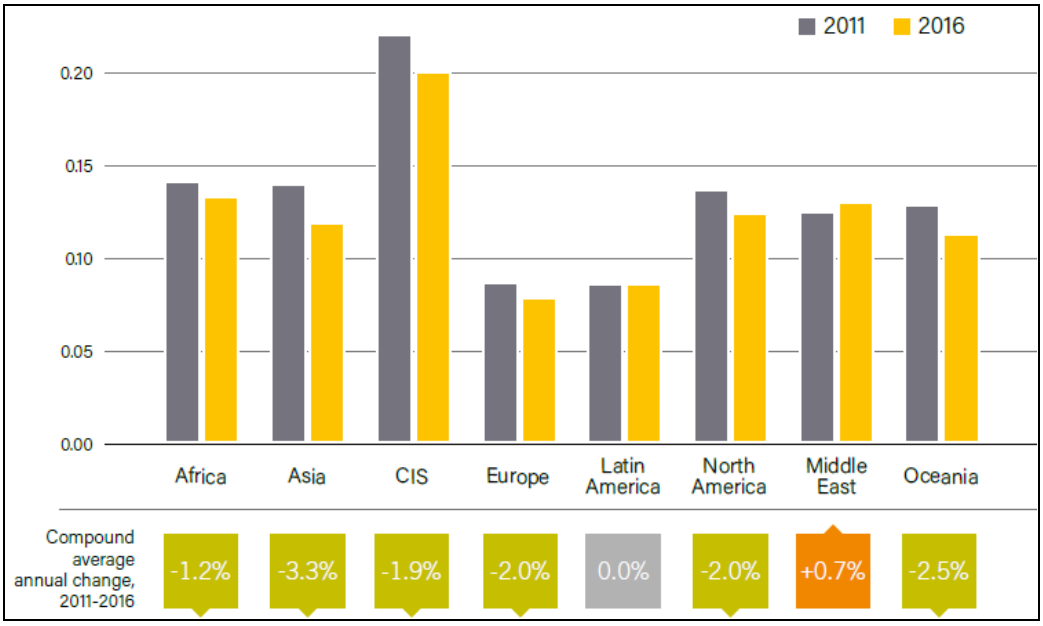
A. Energy Intensity of Gross Domestic Product indicator (EI / GDP)

This indicator was reached in MENA region about 0.2 tons of oil equivalent / $ 1000 in 2010, which is higher than the global average of 0.19 tons of oil equivalent / $ 1000 . [8]

it increase During the 2011-2016 period in MENA countries as shown in the following figure:

Figure (1): Primary Energy Intensity of Gross Domestic Product, Selected Regions (Average Annual Change : 2011 – 2016)

Unit (kgoe /USD2015ppp)



CIS = Commonwealth of Independent States

Source: REN21: Renewable Energy Policy Network For The 21st Century, **Renewables 2018, Global Status Report**, 2018, Paris, France, p : 167

It is noted that the only countries in the world where there was an increase in the energy density index during the period 2011-2016 are the Middle East countries, this overall increase indicates a decrease in energy efficiency.

B. Carbon Dioxide Intensity of Energy Consumption for Production of a Unit of GDP

This indicator reflects the intensity of environmental stress resulting from economic activity, as the value of this indicator is directly proportional to the severity of environmental degradation

in 2009, this indicator was estimated 1.2 (t CO2 / million $ 2000 PPP) which equal three times more than the amount indicator in OCDE (0.4 t CO2 / million $ 2000 PPP[9].Through the following table, it is possible to explain the development that occurred in the value of variation during the years 1990 and 2012:

Table (1) : Carbon Dioxide Intensity For Production On Unit Of GDP, Selected Regions And World (Value Of Variation 1990-2012)

Unit (t CO2 / million $ 2005 PPP)

regions	1990	2013	the value of variation 2012-1990%
North America	555	352	-36,7
Latin America	216	207	-4,0
ex-URSS And Europe	565	307	-46,6
Africa	285	241	-15 ,6
Middle East	311	378	+21,5
Extreme East	504	422	-16,3
Oceania	571	413	-27,6
world	**516**	**368**	**-28,7**

Source : Florine Wong et autres**. Chiffres Clés Du Climat : France et Monde**, Repères Édition 2016, France, 2016, p : 20

It is noted that CO2 emissions per unit of GDP have witnessed a decrease in all regions of the world, and thus the global rate decreased during the period 1990-2013 by more than 28%, and was the only increase in the Middle East countries by more than 21% 5 (from 311 g/$ 2005 PPP to 378 g/$ 2005 PPP . which means that the region became used more energy (more CO2 emissions) to product one unit of GDP.

2. Contribution Of The Residential Sector To Energy Consumption In MENA Region

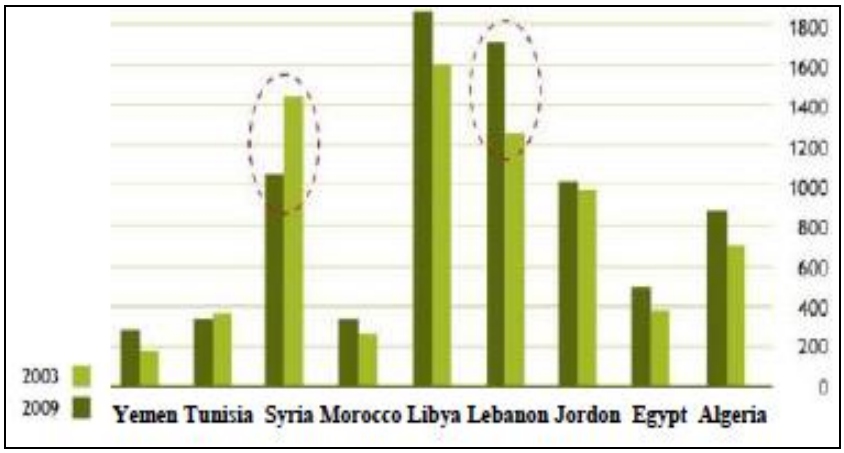
In 2016, electricity comprised an estimated 31% of building energy use in the world.[10], In MENA region, energy consumption has witnessed a remarkable increase during the past years, and the final consumption of energy in the region is expected to grow in 2020 to reach more than 620 million tons of oil equivalent, an increase of 60% from 2011, and to 860 million tons of oil equivalent in 2025, an increase 120%for the year 2011. ([11])

In the Arab countries of the MENA region, buildings constitute an average of 35% of the total energy consumption., which increases the financial burden on consumers as well as on governments due to the subsidy policy.

Also, the **final energy consumption by residential houses** multiplied in MENA region during the period 2003-2009, like it is following in figure (2):

Figure (2): The Share Of The Residential Houses In The Final Energy Consumption In Some MENA Countries

Unit: (kg e oil/ house)



Source: R. Missaoui, H. Ben Hassine and A. Mourtada, **Energy efficiency indicators in the Southern and Eastern Mediterranean countries**, (Regional report), October 2012, p : 54

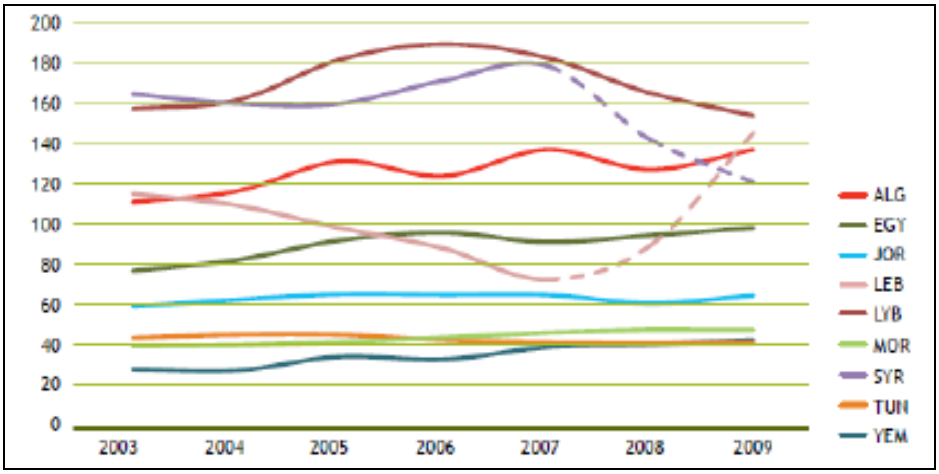
It can noted that the rate of final energy consumption in the residential houses is very big especially in Libya, Lebanon, Jordon and Algeria, which means that is a problem in this consumption.

The overall energy intensity of the buildings sector (measured as final energy use per unit of floor area) declined at an average annual rate of 1.3% from 2010 to 2014, due primarily to the continued adoption and enforcement of building energy codes and efficiency standards. [12]

It can highlight the variation of this indicator during the period 2003 – 2009 in some part of MENA region which is Southern and Eastern Mediterranean countries:

Figure (3): Energy Specific Consumption Per Unit Area Of Dwelling In A Sample Of MENA Countries For 2003 To 2009

Unit (kwh/ $m^{2)}$



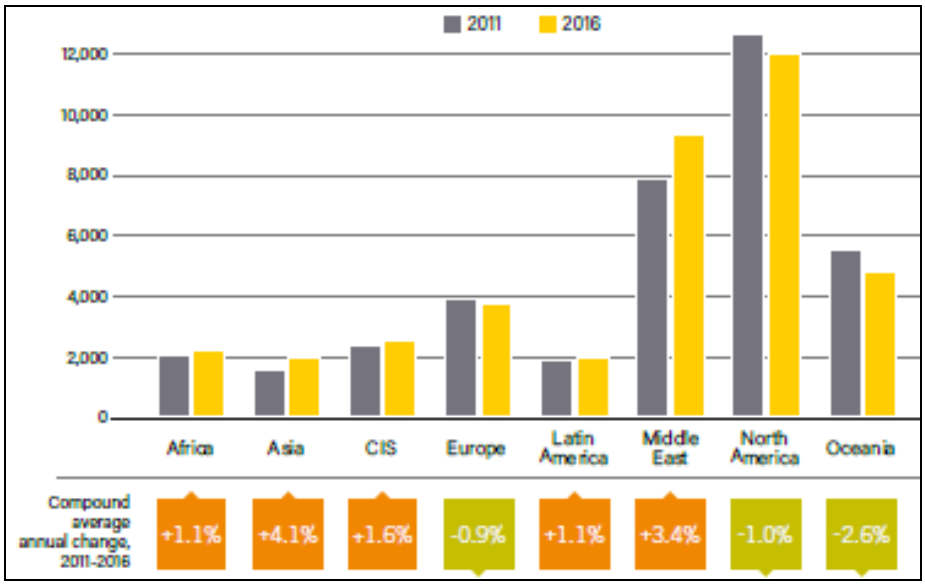
Source: R. Missaoui, H. Ben Hassine and A. Mourtada, **Energy efficiency indicators in the Southern and Eastern Mediterranean countries, (Regional report)**, October 2012, **p :51**

It can noted that Libya has the highest levels of specific energy consumptions, then Syria, while Yemen, Tunisia and Morocco show the lowest specific energy consumption rate.

About electricity like a kind of energy, it can use The average electricity consumption per Electrified Household as an indicator which is illustrated in the following figure:

Figure (4): The Average Electricity Consumption Per Electrified Household, Selected Regions And World (Value Of Annual Variation 2011-2016)

Unit (Kilowatt-hours per household)



CIS = Commonwealth of Independent States

Source: REN21: Renewable Energy Policy Network For The 21st Century, **Renewables 2018, Global Status Report**, 2018, Paris, France, p : 169

It is clear that during the period 2011-2016 the global average consumption of electricity from household electrical appliances increased nearly by 1%, and the highest increase is considered in Asia by 4.1%, followed by the Middle East countries by 3.4%, in the reason of several reasons, the most important of which is the increase in population growth and the consumption pattern of families and individuals.

so that, it can use low embodied energy materials in buildings to reduce the energy consumption in buildings greatly and also minimize the environmental impacts of building construction. [13]

3 . Improving Energy Efficiency Approaches In The Residential Buildings.

Efficiency of energy use in buildings is affected by building envelopes, design and orientation, as well as by the efficiency of energy-consuming devices, including climate-control systems, lighting, appliances and office equipment.[14]

There are many synergies between existing buildings and energy-efficient and renewable energy technologies. Conserving and rehabilitating existing buildings to operate more efficiently and can reduce energy consumed and it's cost, and GHG emissions. the new buildings also optimize the energy previously expended that is associated with the embodied energy in the building's materials and past construction. existing buildings are prime candidates for energy efficiency and renewable energy technologies. historic buildings also have energy-efficient features, such as natural daylighting, ventilation, and thermal storage, included in the building design. [15]

Generally there are four broad ways to reduce the energy consumption of building to be more efficiency, which are described as follows:[16]

- Comfort passive building design and its orientation for harnessing solar energy.
- Low embodied energy materials for building construction such as Aluminum, steel and glass
- Energy efficient domestic appliance to conserve the building operational energy.
- Building integrated renewable energy technologies.

The energy efficient building laws and standards are generally used to define the minimum energy-efficient design and construction requirements for new and renewed buildings. As energy-efficient buildings provide economic and environmental benefits in addition to their advanced architectural advantages, they also contribute to creating economic opportunities for business and industry by encouraging the demand for new materials and technologies. In addition to energy efficient design and construction techniques, energy efficiency in buildings can be improved by choosing equipment such as heating, cooling, and lighting systems, household electrical appliances (refrigerators, washing machines, dishwashers ...) and water supplies (economic savings may reach 60 % of current energy consumption) [17]

4. Energy Economizing Capabilities From Energy Efficiency Measures In The Residential Sector In MENA Region

From the foregoing, there is a necessity of the MENA countries in the contemporary approach towards energy efficiency in residential building and construction, that are part of the trend towards achieving sustainable development, specially that this sector in the MENA region provides an attractive range for energy efficiency and emissions reduction.

Estimates await that the potential to save energy from energy efficiency measures in the MENA region will be around 22 % in 2020 as a proportion of the total expected primary energy supply, and around 21% in 2025. The housing sector ranks second after the industrial sector during the study period in terms of contributing to Savings, with 19% of the total savings.[18]

Countries in the region vary in efforts to improve energy efficiency. The following table shows the Capabilities for energy economizing from energy efficiency in a sample of MENA countries until the year 2025

Table (2): Energy Efficiency Economizing Capabilities in some MENA Countries in 2025

COUNTRIES	Available Energy Economizing Capabilities (1000 teo 2015)	available Energy economizing Capabilities in total primary energy (%(TPES))
Saudi Arabia	**102.418**	**25**
UAE	**41.339**	**25**
Egypt	**32.794**	**20**
Oman	**21.115**	**28**
Algeria	**20.236**	**30**
Iraq	**18.071**	**11**

Kuwait	**15.428**	**26**
Qatar	**12.079**	**6**
morocco	**10.362**	**19**
COUNTRIES	**Available Energy Economizing Capabilities (1000 teo 2015)**	**available Energy economizing Capabilities in total primary energy (%(TPES))**
Sudan	**6.375**	**19**
Libya	**5.125**	**37**
Bahrain	**3.168**	**14**
Lebanon	**2.434**	**33**
Tunisia	**2.412**	**14**
Jordon	**2.046**	**13**
Yemen	**1.271**	**23**
West Bank and Gaza	**671**	**21**
Total saving energy	**297.344**	

Source: : The International Bank for Reconstruction and Development**, Energy Efficiency in the Middle East and North Africa, Energy Efficiency Capabilities in the Industry, Services, and Residential Sectors,** World Bank Publications, Washington, USA, 2016, p:10

It appears from the table that there is a percentage in savings rates from 6 % in Qatar to the highest percentage in Libya, which ranks first in terms of energy savings by 37%, followed by Lebanon and Algeria.

As for the housing sector, it offers a great opportunity to rationalize energy consumption, but it faces a major obstacle in terms of supporting energy prices in this sector, which requires correcting large efforts over a long period. It can illustrate the extent of the economizing annual energy's possibility in this sector in a sample of region's countries until year 2025 by the following table:

Table (3): Capabilities Of Economizing Energy From Energy Efficiency In The Residential Sector In A Sample Of MENA Countries

country	economizing energy (k t e oil)	Percentage (%)
Algeria	3.543	23.1
Egypt	8.497	25.9
Jordon	609	28.9
Lebanon	754	31.0
KSA	20.144	21.2
Morocco	3.285	31.7
UAE	6.077	14.7
Qatar	1.667	13.8
Iraq	2.087	11.5
Kuwait	3.658	23.7

Source: The International Bank for Reconstruction and Development, **Energy Efficiency in the Middle East and North Africa, Energy Efficiency Capabilities in the Industry, Services, and Industrial Sectors**, World Bank Publications, Washington, USA, 2016, p: 12

It is noted that the housing sector can economize energy consumed significantly in the region, especially in KSA, UAE, Egypt, Morocco and Algeria.

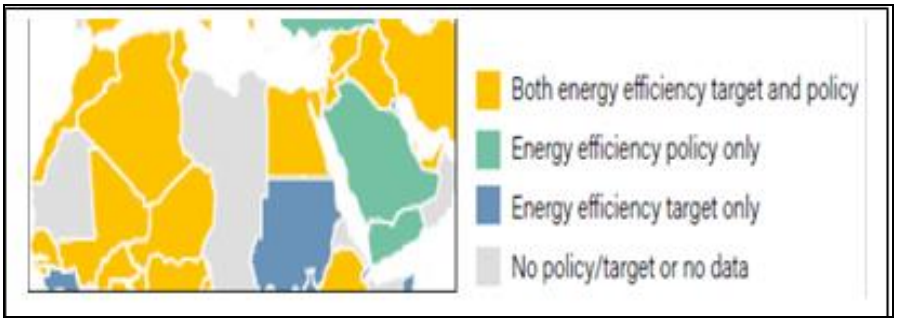
5. The Trak Of The MENA Countries Towards Improving Energy Efficiency In The Residential Sector

Many MENA countries have plans and programs for energy efficiency in the residential sector, and many of them set energy efficiency conditions in new buildings. In December 2010, the League of Arab States issued the first Arab energy efficiency guidelines stipulating the development of local action plans for energy efficiency in buildings[19]

Currently, work is underway to issue a unified Arab green building code that includes determinate specifications for water use, energy efficiency, cooling systems, resource reuse and recycling, and air quality.[20]

Many countries of the world have set energy efficiency goals as they have reached about 157 countries due to the importance of this matter, and many MENA countries fall within this number, and the availability of energy efficiency goals and policies can be illustrated by the following figure:

Figure (5): Energy Efficiency Policies and targets in MENA Countries Until End 2017



Source: REN21: **Renewable Energy Policy Network For The 21st Century, Renewables 2018,** Global Status Report, 2018, Paris, France, p : 54

It is remarked from the figure that most countries in the Middle East and North Africa have set energy efficiency goals, while countries such as Algeria, Egypt, Tunisia and Morocco have set policies to achieve energy efficiency targets.

Energy efficiency policies and programs affect several sectors such as industry, transport, service buildings and residential sector. It may look at the extent of adopting energy efficiency standards and programs in the residential sector in a sample of the countries of MENA region in the following table:

Table (4): Aims of Energy Efficiency Strategies for a Sample of MENA Countries

Countries	Goals	Date of goal	Total Goal
KSA	Increasing energy efficiency in buildings		
	Creating and Generalizing adminstration energy system	2017-2008	
	Energy intensity improvement relative to total GDP from 202 kWh / 1000 Saudi Riyals in 2005 to 140 kWh 1000 / Saudi Riyals in 2030	2030	140 kWh 1000 / Saudi Riyals
	generalization the energy efficiency standards and labels system		
	Promote the spread of energy-efficient building technologies		
Algeria	Thermal insulation of buildings, reduced energy consumption associated with heating and air conditioning housing in the residential sector	2030	100000 house/ year
	Generalizing the use of economic lights in the residential sector	2030	10 million lamps/ year
	Solar heater development, as a gradual alternative to the traditional heater in the individual / group residential sector	2030	100000 house/ year
Iraq	Reducing final energy consumption from 5% to 10%in the end of 2016		
UAE	Creating building laws that focus on ways to conserve and rationalize energy consumption in all types of buildings		
Jordon	Reducing electricity consumption in all sectors	2020	20%
Egypt	Distributing 12 million energy saving lamps in the domestic sector at half price	2015-2012	12 million lamps

Source: Secretariat of the Arab Ministerial Council for Electricity, League of Arab States**, Guide to Renewable Energies and Energy Efficiency in Arab Countries,** Cairo, Egypt, 2015, pp. 41-44

Although many energy efficient building laws are available, many of these laws have not been enforced, but rather have been made as voluntary standards.

Among the regional projects about this area in the region is MEDENEC (Mediterranean Energy Efficiency in the Construction sector) project , it's related to energy efficiency in the construction

sector in the countries of the Mediterranean basin, funded by the European Union to increase the use of energy efficiency measures and renewable energy systems in buildings in the Southern and Eastern Mediterranean countries, which will benefit many countries in the Middle East and North Africa. There is also the RCREEE project to compile a regional database on RE & EE.[21]

6. Policies and Mechanisms for improving energy efficiency in the residential sector in Algeria

Algeria has implemented, in the framework of improving energy efficiency, a set of energy policies and programs targeting all economic sectors, including the construction sector, and has framed this policy with a set of legislation and laws, the most prominent of which are :

- Executive Decree No. 2000-90 April 2000, which includes thermoregulation in new buildings.
- Law No. 99-09 of 28 July 1999 on Energy Control. The most important practical measures included in the construction sector are the introduction of energy efficiency standards in new buildings and monitoring of energy-use devices, as the thermal insulation standards in these buildings allow for a reduction of about 50% of consumption[22]

The National Energy Control Program (PNME) is the first experience of its kind in Algeria in the field of energy control, and it includes several projects, procedures and measures that must be developed in many fields, including: energy saving and renewable energies development, setting energy efficiency standards, reducing energy impacts on the environment…and the National Fund for Energy Control finances this program, while the National Agency for the Promotion and Rationalization of Energy Use is responsible for its implementation and follow-up. Among its most important projects in the construction sector are the following[23]:

- **Lighting Economy Program**: It distributes a million lamps with low energy consumption to the family sector, and seeks through it to reduce electricity consumption bills and achieve economic energy. The fund provides direct support of 50 %of the sale price of the lamps
- **The Shams Algeria program**: Distributes 1,000 solar water heaters across the country for the benefit of families, and aims to save energy and reduce greenhouse gas emissions. The box supports the cost of the solar heater by 45 %.
- **Energy saving program**: works to achieve 600 housing units with high energy efficiency, it goals to improve thermal well-being in housing and reduce energy consumption in heating and air conditioning, introducing aspects of energy control during architectural design. The fund shall bear 80 %of additional costs incurred by introducing energy control, whether during design or construction.

The National Agency for the Promotion and Rationalization of Energy Use has evaluated the energy outcome of the National Program for Energy Control in the residential sector until the year 2013, and it is shown that the program contributed to the economy of energy by about 168539 tons of oil equivalent, and in the reduction of polluted gas emissions by approximately 387640 tons of carbon dioxide. However, the number of targeted housing to improve energy efficiency in it is considered very small compared to the number of housing and buildings residential in Algeria.

6. Economic, Environmental And Social Effects Of The Shift Towards Energy Efficiency In The Residential Sector (WORLD and MENA)

A. Economic impacts

The economic benefits of energy-efficient buildings are the savings in energy bills, and despite the high initial costs of energy-efficient construction, its positive impact appears on the life cycle costs of the building, where analytical studies in the United States of America indicate that an investment of about 2 % of the initial construction costs (energy) Water, waste, emissions, operation, maintenance, productivity, and health) usually generate lifetime savings more than 10 times the value of the initial investment.[24]

Numerous estimates, including the International Energy Agency's estimates, indicate that investments in greening buildings of $ 300-1000 billion annually until 2050 can achieve energy savings of nearly a third in the buildings sector globally, compared to projections under an approach The usual work. Government policies are very important to achieve these benefits, and the sustainable building and construction initiative within the framework of the United Nations Environment Program and its partners has demonstrated that the most efficient and cost-effective policies, among a large number of possible policy tools, are efficiency in the use of materials, land, and water, and reducing Waste, and the construction sector has tremendous potential, especially in developing countries including the countries of the Middle East and North Africa.[25]

The IEA report estimates that a global investment of an additional $ 2.5 trillion in green buildings during the period 2010-2030 will result in a saving of $ 5 trillion in energy during the investment period[26], and If no action is taken to improve EE, global energy demand is projected to rise by 50% by 2050. [27]

As for the countries of the Middle East and North Africa, the Energy Efficiency in Buildings Project in Tunisia, launched in 1999, achieved energy savings at a rate of 33 %), and in Jordan, potential energy savings from modernizing existing commercial buildings were estimated at 20 % at recoverable costs in a year and a half, and in the residential sector it is possible Provide an average of 30 % in simple procedures such as improving lighting and water supplies and monitoring water and energy leaks.[28]

The presence of large numbers of old and ineffective buildings means that renovating them can lead to great environmental benefits. For emerging and developing countries, the direct transition to energy-efficient new buildings will avoid the waste of strong energy consumption. [29]

Given that the buildings sector in the Arab countries consumes 748 billion kilowatt hours per year, the application of this reduction rate means a reduction of 217 billion kilowatt hours of consumption in 2020, and this saves 17.5 billion dollars annually.[30]

It should be noted that the consumer also has an important role in saving energy, whatever the degree of efficiency of energy systems, and what is confirmed by the results of a recent analysis of the World Business Council for Sustainable Development, which shows that extravagance can add a third to energy consumption in the building, and in return, frugal behavior can provide a third.[31]

B. Environmental impacts

Energy efficiency is a mean to reduce carbon dioxide (CO2) emissions, so that the energy-efficient building can be linked with sustainable development goals (SDGs): SDG 11, aimed at “making cities and human settlements inclusive, safe, resilient and sustainable” ,and SDG 13 that calls for “urgent action to combat climate change and its impacts.” [32]

Energy efficiency measures in buildings have positive effects on the environmental challenges facing the region, and since buildings consume a large proportion of energy, the inclusion of environmental protection standards in old and new buildings will reduce air pollution rates[33] .

The 2007 Intergovernmental Panel on Climate Change report predicts that measures to improve energy efficiency in buildings are one of the most cost-effective ways to combat climate change, based on expectations of lowering greenhouse gas costs in key economic sectors, where it could lead to a reduction of about 29 More emissions than expected by 2020, more than in any other sector[34].

C. Social impacts

There is many studies demonstrated that improvements in human health and well-being were correlated with improvements in the EE of buildings which have a positive impacts of energy efficiency for social well-being and improve social development. [35]

The application of energy-efficient building practices is useful in creating new jobs. These jobs are green jobs because they contribute to preserving the environment and contribute to reducing energy consumption, reducing greenhouse gas emissions and pollution, and combating climate change.[36]

This sector has the highest multiplier effects on employment and the creation of small and medium-sized companies, and this effect increases with the spread of energy efficiency standards and increased demand for energy-efficient building elements and equipment such as efficient lighting, heating and air-conditioning systems ... and electrical equipment and installations that meet energy efficiency standards[37] .

Among the indications of the positive social role of investment in energy efficiency in buildings are the following:

- An estimate in the US housing market indicates that every investment of $ 1 million in construction efficiency updates would create 10-14 direct jobs and 3-4 indirect jobs. If we drop these estimates on the housing sector in the MENA region, it is expected that the job creation rate will double due to the average worker productivity and cost factors in this sector in the region. By providing 40 direct and indirect jobs for each investment with the same amount. That is, an investment of $ 5,000 per building to upgrade energy and water efficiency in 10 million buildings (20% of the stock of residential buildings in the Arab countries of the Middle East and North Africa region) within ten years would create two million jobs[38] .

- An evaluation of the effects of the European Union - long-term directive (2011-2050) on energy performance in construction concluded that accelerating the pace of renewal would create an annual average of between 0.5 and 1.1 million jobs, and a US study concluded that Renewals based on energy efficiency of old buildings dating back to 1980 will reduce electricity use by 30% and create more than 3.3 million cumulative jobs annually .[39]

Thus, energy efficiency in the construction and residential sector provides many opportunities in the MENA region, especially since youth unemployment is the highest in the world according to the International Labor Organization, the implementation of energy efficiency programs provides a large number of jobs in Arab countries with about 1.6 million jobs, especially in Egypt where it approaches 700 thousand jobs, and Algeria and Morocco with more than 200 thousand and 180 thousand, and new energy-efficient buildings provide the largest percentage of these jobs in most countries[40].

Energy efficient buildings can also be a complementary strategy for developing access to basic services and improving the living conditions of the poor and low-income people. Especially since many studies have shown that the advantages of environmental design do not require a higher cost than the traditional design of low-income housing.

7 . Requirements for successful implementation of energy efficiency policies in MENA

Successful planning and implementation of energy efficiency programs requires the availability of a number of pillars, the most important of which are:

- Subsidy energy Reforms: Because energy subsidies have contributed to the exaggeration of energy consumption, that subsidies are large and pervasive for both advanced and developing countries and among oil-producing and non-oil-producing countries alike .which made it a heavy burden on the budgets of governments in the region, North Africa region (where there is substantial undercharging for petroleum's supply and environmental costs) accounts for 7 percent of the global subsidy[41] .it also led to an acceleration of their depletion rates in addition to the environmental degradation caused by it. Therefore, the continuation of this support for energy prices will lead to frustration efforts to sustain energy resources and increase the environmental costs that the subsidized prices do not take into account. should be noted that the Middle East and North Africa region is one of the first regions in the world to support energy with almost 48% of the sum of 5236.5 billion in the world in 2011, from which it is necessary to gradually stop providing this unsustainable support that contributes to environmental degradation regardless of its benefits.[42]

This reform has a large benefits: environmental, fiscal, and economic welfare.* About CO2 reductions MENA region has the biggest proportionate with (35 percent) from the global CO2 reducing (21 percent), (despite the lack of coal use there), which are due to the large increases in petroleum product prices implied by getting energy prices righ, about the reduction in premature fossil fuel air pollution deaths, it was more than 50 percent, while the welfare gains of energy price reform are estimated around 200 billions US dollars (nominal) , which was around 4.8 percent of GDP (the global welfare gains was more than 1.4 trillion $ or 2.0 percent of global GDP). In terms of fiscal benefits, global revenue gains from getting energy prices right are estimated at about $3.0 trillion, or 4 percent of global GDP., while in MENA region was around 400 billions US dollars , or 10 percent of GDP, or around 30 percent of revenue in this region. [43]

And this reform will continue in many countries of Middle East with large price subsidies (such as Bahrain, Egypt, Kuwait, Iran ,Oman, Qatar, Saudi Arabia, United Arab Emirates) have also started to decrease subsidies as part of a gradual (e.g., 5 year) plan to eliminate subsidies. [44]

- Reforming the legislative and institutional framework to ensure improved energy efficiency in buildings.
- Incorporating energy efficiency standards into residential building design and household electrical appliances.
- Provide incentives to purchase energy efficient home appliances and equipment from end-users.
- Energy efficiency research support.
- Educating consumers about the importance of rationalizing energy consumption and the opportunities available to improve its efficiency.

In addition to : [45]

- A package of building standards, credit and incentives policies, as well as intermediaries such as energy services companies, provide enhanced green building renovation activities, while attracting public financing for private investment.
- Provides specialized facilities and specialized and qualified workers, which requires upgrading skills and issuing certificates to construction companies, giving the organized feature and making improvements to work conditions in order to retain qualified workers

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IV. STUDY RESULTS (ANALYSIS AND DISCUSSION) :

The most important results reached through this research paper are as follows:

- Energy efficiency in MENA countries is weak compared to many regions of the world based on several indicators such as the energy intensity index, and the CO2 emission index resulting from consumption energy
- The residential sector is one of the largest energy-consuming sectors globally and in the MENA region, where residential buildings alone account for 27% of consumption, so that Improving energy efficiency in this sector is a necessity for MENA countries to move towards sustainable development.
- Energy efficient design techniques and building standards are generally used to improve energy efficiency in residences, additional to the selection of energy efficient systems and equipment such as heating systems, and household electrical appliances.
- The residential sector has the greatest potential to improve energy efficiency, as it provides in the MENA region an attractive area for energy efficiency and emissions reduction.

So it can say that the **study's hypothese is right**, and Many MENA countries have different plans and programs for energy efficiency in the residential sector, and many of them set energy efficiency conditions and laws in new buildings, but it still far than achieving its goal in comparing with its improving energy efficiency capabilities, because they are considered voluntary standards in many of them and their application has not been imposed.

- In the framework of improving energy efficiency, Algeria has implemented a number of energy policies and programs targeting the construction sector, the most prominent of which is the National Energy Control Program.
- economic benefits of energy efficient buildings are savings in energy bills whose costs exceed initial costs by up to ten times, in addition to expanding energy production systems and devices.
- Energy efficiency measures in buildings have a positive environmental impact, which is to reduce energy consumption, reduce emissions and pollution and combat climate change.
- Energy efficiency measures in buildings have a positive social impact, which is the creation of jobs directly and indirectly due to the increased demand for energy efficiency systems and equipment. In addition to its role in improving the welfare and living conditions of the population.

V. CONCLUSION:

The shift towards investing in energy efficiency is considered a main pillar for the sustainability of energy sector in the MENA region during the current period, by shifting towards more efficient and sustainable energy production and consumption patterns to contribute to achieving one of the most important goals of the United Nations' sustainable energy development goal, which is Double the global rate of improvement in energy efficiency by 2030.

Recommendations:

- Successful planning and implementation of energy efficiency programs in the MENA region requires a number of pillars, the most important of which are support reforms, which is the largest in the same region, in addition to reforming the legislative and institutional framework.
- providing the necessary funding for the success of implementing energy efficiency policies.
- providing specialized facilities, upgrading workers' skills raising awareness
- The consumer is concerned with the importance of rationalizing energy consumption and the opportunities for improving its efficiency.

VI. REFERENCES:

[1] REN21 :Renewable Energy Policy Network For The 21st Century, **Renewables 2018, Global Status Report**, 2018, Paris, France,.PP:165- 232
[2] AmirHosein GhaffarianHoseini a,n and al. **Sustainable energy performances of green buildings: A review of current theories, implementations and challenges**. Renewable and Sustainable Energy Reviews 25 (2013), p:6
[3] A. Chel, G. Kaushik, Renewable energy technologies for an energy efficient building, Alexandria Engineering Journal (2018) 57, p: 660
[4] BP, **Energy Outlook** 2016, p: 45
[5] R. Missaoui, H. Ben Hassine and A. Mourtada, **Energy efficiency indicators in the Southern and Eastern Mediterranean countries**, (Regional report), October 2012, p,p : 71,75 .
[6] .SHEILA J. HAYTER, Alicen Kandt. **Renewable Energy Applications for Existing Buildings**. the 48th AiCARR International Conference Baveno-Lago Maggiore, Italy, September 22-23, 2011, p: 1.
[7] REN21. **Op. cit**. P: 232
[8] (AFED) The Arab Forum for Environment and Development (AFED), **The ninth Annual Report of the Forum,** Technical Publications, Beirut, Lebanon, 2016, p: 34.
[9] R. Missaoui, H. Ben Hassine and A. Mourtada, **op.cit**. p :35
[10] Ren21. **Op. cit.** P: 168
[11] The International Bank for Reconstruction and Development, **Energy Efficiency in the Middle East and North Africa, Energy Efficiency Capabilities in the Industry, Services, and Industrial Sectors**, World Bank Publications, Washington, USA, 2016, p p : 6-7
[12] Rren21. **Op. cit**. P: 168
[13] (A. Chel, G. Kaushik, **op. cit**. p: 660)
[14] RN21, **op. cit**, p : 168
[15] .SHEILA J. HAYTER, ALICEN KANDT ,**op. cit**. p: 13
[16] A. Chel, G. Kaushik. Renewable energy technologies for an energy efficient building, Alexandria Engineering Journal , (2018) 57, pp:660, 656-657
[17]The Arab Forum for Environment and Development (AFED), **Green Economy in a Arab change World**, The Fourth Annual Report of the Forum, Technical Publications, Beirut, Lebanon, 2011. P: 183
[18] The International Bank for Reconstruction and Development , **Op. Cit**. p: 9
[19] .AFED, **op.cit**. 2011. P: 187
[20] Economic and Social Commission for Western Asia (ESCWA), **Green Economy in the Context of Sustainable Development and Poverty Eradication**, Principles, Opportunities and Challenges in the Arab Region, New York: United Nations Publications, 2011, p p: 27- 28
[21]. R. Missaoui, H. Ben Hassine and A. **Op. Cit**. p:5
[22] Agence Nationale Pour La Promotion Et La Rationalisation De L'energie (APRUE), **Recueil De Textes Législatifs et Reglementaires sur la Maitrise de l'Energie**, Algérie, 2010, pp :7 -10.
[23] Ministère De L'énergie Et Des Mines , **Programme des énergies renouvelables et de l'efficacité énergétique,** Algérie, 2011, p p : 14-15
[24] AFED, **Op.cit**. 2011, p: 195
[25] United Nations Environment Program, **Towards a Green Economy: Pathways to Sustainable Development and Poverty** Eradication , UNEP Publications, New York, USA, 2011,p 22
[26] International Labour Office (ILO), **Sustainable Development, Decent Work And Green Jobs**, First edition, ILO publications, Report V, Geneva, Switzerland, 2013, p: 40
[27] Giacomo Di Foggia, **Energy efficiency measures in buildings for achieving sustainable development goals**, Heliyon review, 4 (2018), p:2
[28] AFED. **Op .cit** 2011, p : 191
[29] ILO. **Op. cit**. p: 39
[30] AFED. , **Op .cit.** 2011, p : **XXXIII**

[31] **idem.** p: 191
[32] Giacomo Di Foggia, **Op .cit**. p:2
[33] ESKWA. **Op. cit.** p: 65
[34] AFED. **Op .cit** 2011,. P p: 179- 180
[35]Giacomo Di Foggia, **Op. Cit**. p: 4
[36] ILO. **Op. cit** . p: 23
[37] ESKWA. **Op. cit.** p: 65
[38] AFED. **Op .cit** 2011, p: 195
[39] ILO. **Op. cit.** p: 41
[40] AFED. **Op. Cit**. 2011, p: 180
[41] D. Coady et al. **Energy Price Reform: Lessons for Policymakers**. Review of Environmental Economics and Policy, volume 12, issue 2, Summer 2018, pp: 204-205
[42] IMF International Monetary Fund **, Subventions à l'énergie au Moyen-Orient et en Afrique du Nord : Enseignements Pour La Réforme,** washington, U.S.A, 2014, p : 01
[*] This is based on a simple (static) comparison of outcomes that would have occurred in 2013 under a counterfactual with fully efficient energy prices versus outcomes under actual prices.
[43] D. Coady et al. **Op. Cit**. pp: 205-206
[44] **Idem**, p: 210)
[45] ILO. **Op. cit.** p: 40