Applying the new sustainable urban development towards the location of the renewable energy resources in Egypt

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Abstract:

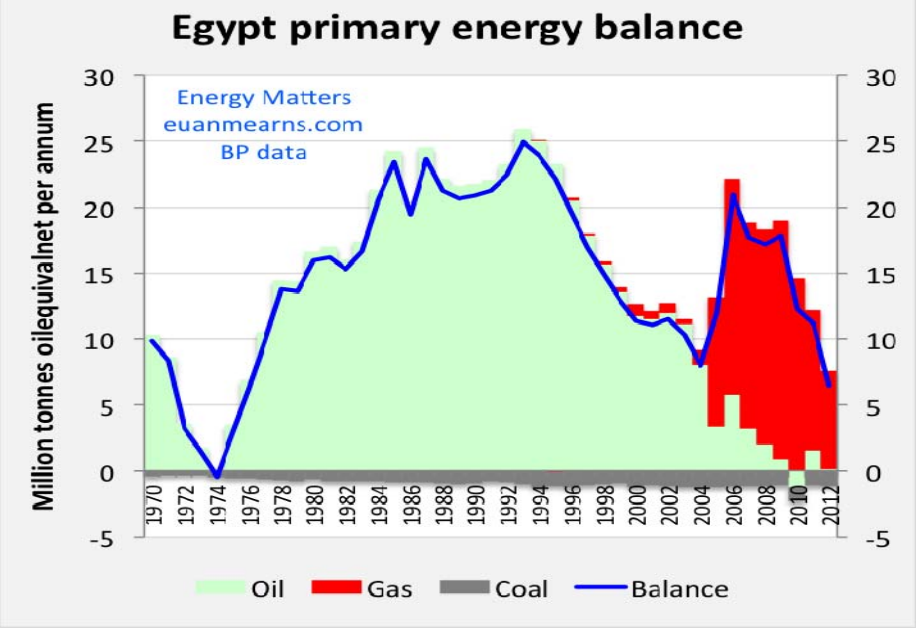
Sustainable urban growth nowadays is not an option for big cities all over the world. It is a mandatory to protect the environment and our planet for grandsons' future. We should work through a strategy, which aims to satisfy development needs of energy. This strategy depends on diversifying energy resources and achieving the most benefit of it besides improving energy production and its utilization. In addition, the strategy should aim also at environmental conservation and improving local manufacturing of energy equipment. We should study the potential locations in Egypt of generating clean energy from (wind, solar, wave, and biomass) in the making of strategies for a sustainable development. Such strategies typically involve three major technological changes: energy savings on the demand side, efficiency improvements in the energy production, and replacement of fossil fuels by various sources of renewable energy. Consequently, large-scale renewable energy implementation plans must include strategies for integrating renewable sources in coherent energy systems influenced by energy savings and efficiency measures. This paper discusses the perspective of renewable energy potential in Egypt and its impact on sustainable development for Egyptian vision 2050

Introduction:

As a means to diversify its energy supply options and mitigate the environmental impacts of fossil fuel based power generation, the government of Egypt has made an ambitious commitment to renewable energy. The 20% renewable energy target set by the supreme energy council is expected to be enlarged by scaling-up of wind and solar energy as the hydro potential is largely utilized. The council has also recently approved key policy steps related to wind power scale-up in the country. These include:

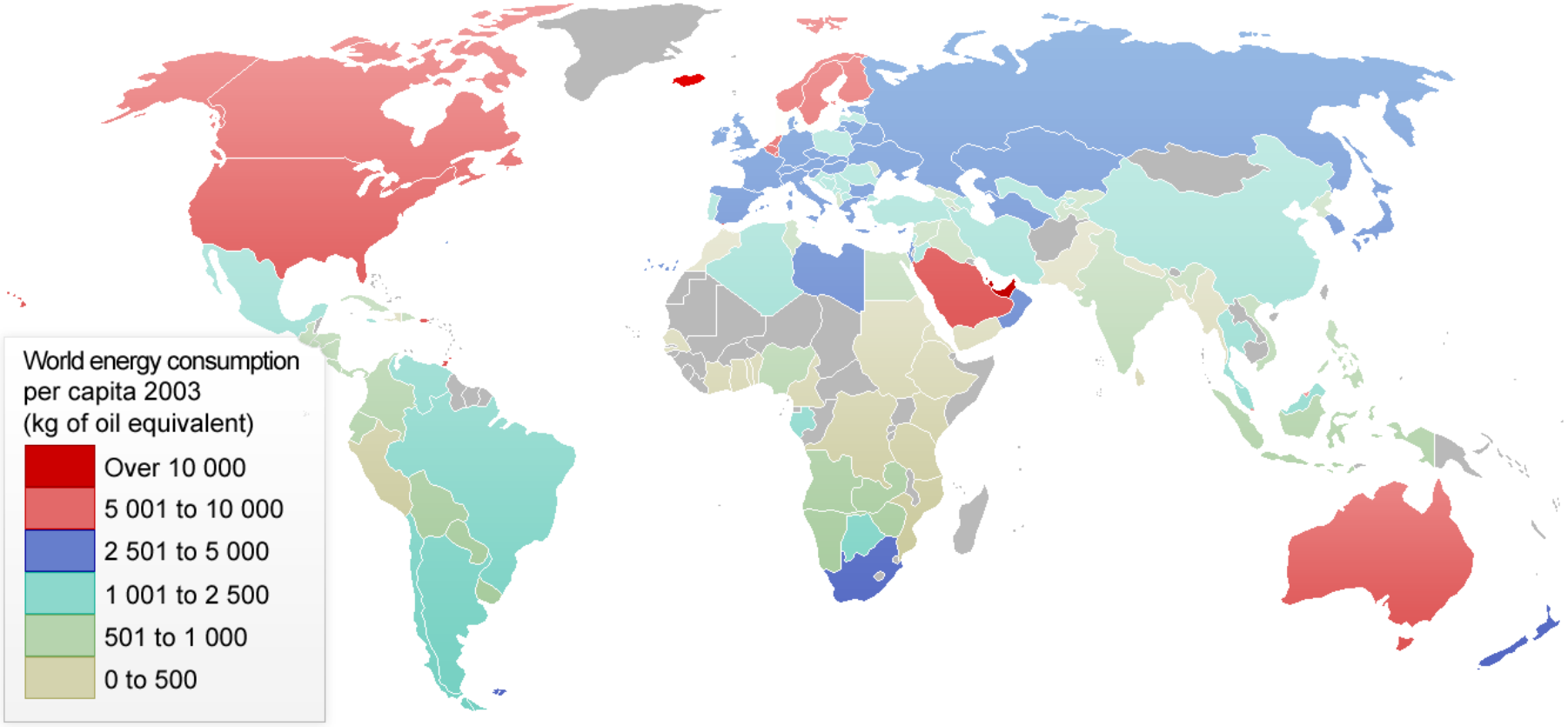
A. Approval by the supreme energy council of the need to cover additional costs for renewable energy projects;
B. Finalization of the land use policy for wind power developers;
C. Approval of zero customs duty on wind equipment
D. Acceptance of foreign currency denominated PPAs and confirmation of central bank guarantees for all BOO projects and
E. Permitting support for developers with respect to environmental, social and defense clearances. These measures are already being implemented pending their adoption as part of the new electricity law.

On the other hand, new sustainable urban development should be supported by renewable energy resources and sustainable transportation.



Introduction:

As The energy consumption per capita reflects the level of living in the country and in most countries reflects the needs of energy for industrial needs. Unfortunately, as illustrated in the below map that Egypt is one of the lowest country for energy consumption. The most important factor to move to the level of countries that have high quality of living standards is energy production. It helps to open new industrial fields and compete in the whole world market products. Even the agriculture needs more energy for mass production and to support the agriculture by its products industry. All economic fields search for energy which mean that new urban developments should be located near energy resources.



Literature review:
1. Lack of energy power types in Egypt

No one can deny that Egypt is under the pressure of lack of energy resources. Lack of car fuel, electricity current cutting all over the country, and refilling gas cylinders for home gas use are enough examples of the disaster we are facing nowadays.

By year 2022 other national resources become available:

The first scenario was based on:

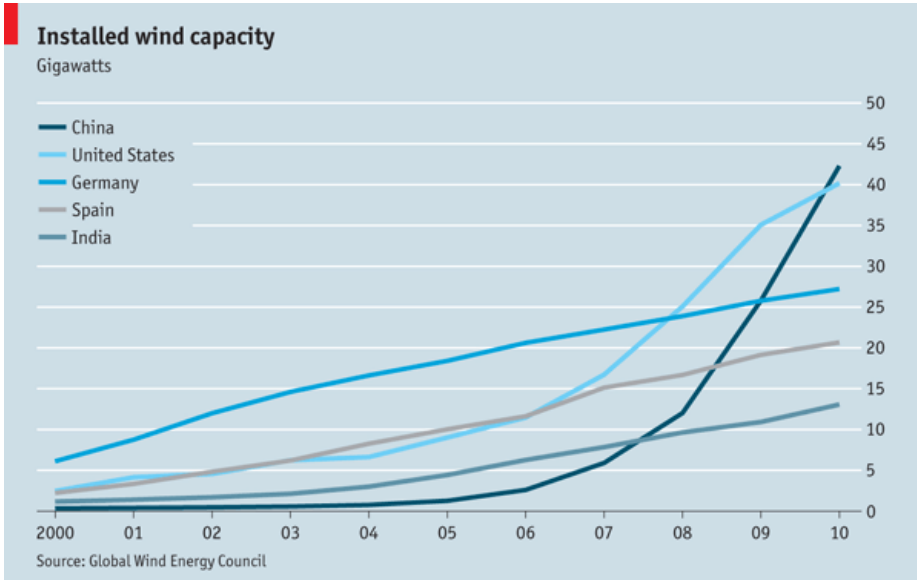
A. Supply of fossil-based energy production will remain at the same level.
B. Wind energy grows, leading to about 20% contributions to electricity generation from renewable (hydro and wind).
C. Nuclear energy would contribute about 6%.
D. The energy supply mix around 2021/2022 becomes:
   - 40 % from (20% fossil fuel and 20% NG)
   - 8 % from energy efficiency implementations
   - 9 % from renewable (2% hydro and 7% wind)
   - 6 % from nuclear

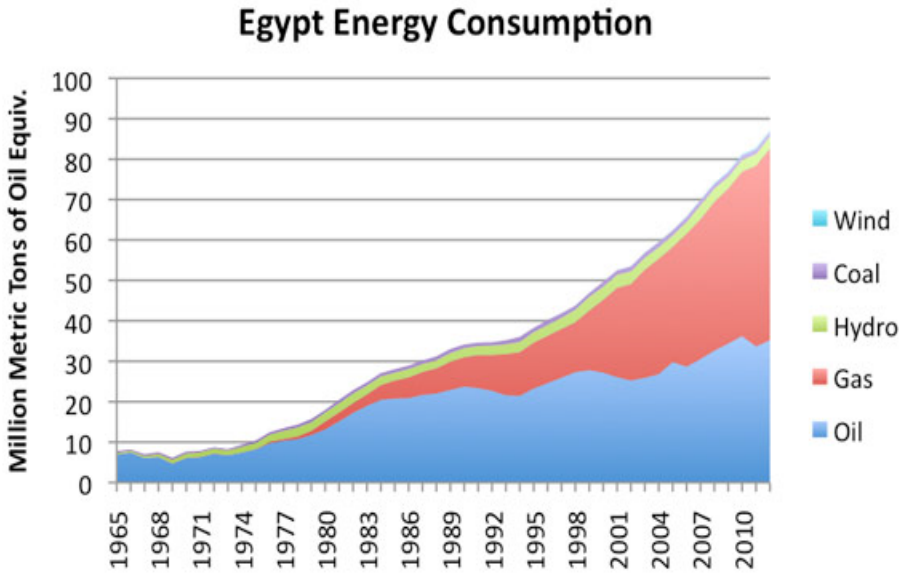
- **% 37additional energy is needed**

Literature review:
2. Lack of using renewable energy resources

Primary Energy Supply:

Egypt is a resource rich country. According to the US Energy Information Administration (EIA), it is the largest non-OPEC oil producer in Africa and the second largest dry natural gas producer on the continent. However, energy production in Egypt has been steadily declining since 2009 and in 2012 reached 82,046 ktoe.This is due to shortages in natural gas supply and oil production being unable to keep up with the energy demand. The shortages have led to frequent electricity blackouts in the country as well as decreasing exports. Factoring in exports and bunkers, Egypt's primary energy supply was 78,214 ktoe in 2012.





Literature review:
3. Energy Consumption in Egypt

Primary Energy Supply:

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Table 1: Final energy consumption in Egypt in 2012 (ktoe)

Total Final Energy Consumption			
		ktoe	%
Industry sector		13,357	23.90
Transport sector		16,980	30.39
Other sectors		18,479	33.07
of which	Residential	11,910	21.31
	Commercial and public services	2,913	5.21
	Agriculture/ Forestry	2,841	5.08
	Non-Specified	814	1.46
Non-energy use		7,062	12.64
Total		55,879	100

Literature review:
4. Egypt problems as historical country

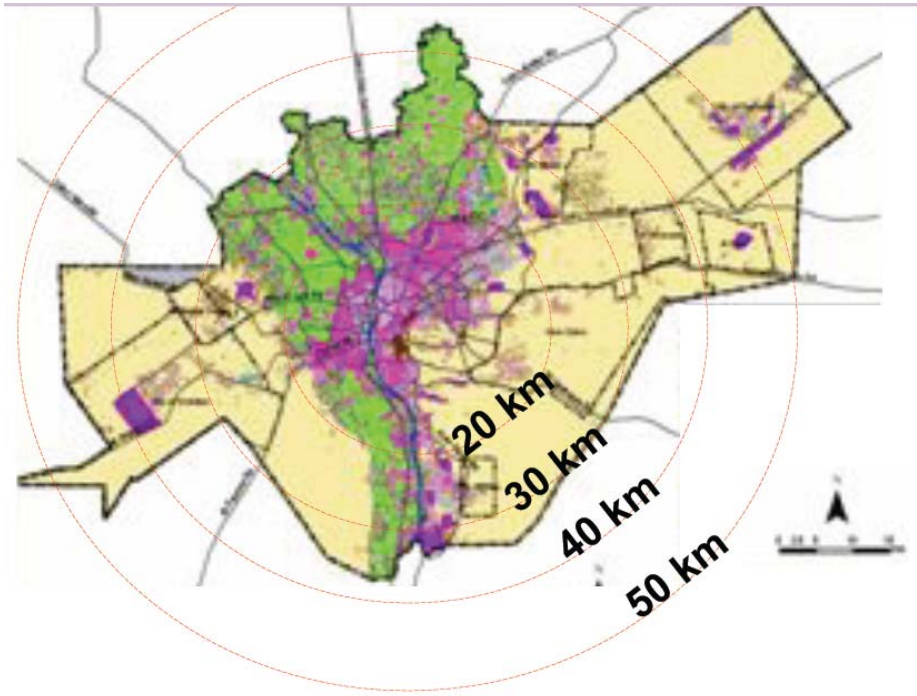
Egypt cities suffer from many problems not limited to the following:

- Cairo is an expanding city, which has led to many environmental problems. The air pollution in Cairo is a matter of serious concern. Dangerous levels of lead, carbon dioxide, sulphur dioxide, and suspended particulate matter concentrations due to decades of unregulated vehicle emissions, urban industrial operations, and chaff and trash burning. There are over 4,500,000 cars on the streets of Cairo.
- Rapid urban expansion resulted in encroachments on agricultural land. Total prime agricultural land lost to urbanization during the period 1952-2002 amounts to 300,000 acres
- An addition of almost 1.35 million overpopulated annually.
- Egypt faces a shortage of affordable housing supply for the poor despite the presence of 5 million vacant units.
- About 440,000-600,000 new housing units are needed annually between now and 2020, of which 300,000 for low income households.
- Optical pollution.
- The underground is the only tool for sustainable transportation.
- Economical problems that create an obstacle to achieve sustainable growth and environmental goals.

Literature review:
4. Egypt problems as historical country

Egypt cities suffer from many problems not limited to the following:

- High residential density in main existing agglomeration
- Rising traffic congestion.
- Limit/mediocre use of culture and natural resources.
- Mediocre living condition in some areas.
- Limited green spaces (0.3 m2 /person within the ring road and 1.5 m2/person in the region as total).
- The challenge is not the size, but the population distribution over the whole region area



Literature review:
5. Renewable energy

5.1 Solar Energy

Sunlight, or solar energy, can be used directly for heating and lighting homes and other buildings, for generating electricity, and for hot water heating, solar cooling, and a variety of commercial and industrial uses.

5.2 Hydroelectric

Wind energy is captured with wind turbines. Then, the winds and the sun's heat cause water to evaporate. When this water vapor turns into rain or snow and flows downhill into rivers or streams, its energy can be captured using hydroelectric power. The energy of the ocean's tides come from the gravitational pull of the moon and the sun upon the Earth. In fact, ocean energy comes from a number of sources. In addition to tidal energy, there's the energy of the ocean's waves, which are driven by both the tides and the winds. The sun also warms the surface of the ocean more than the ocean depths, creating a temperature difference that can be used as an energy source. All these forms of ocean energy can be used to produce electricity

5.3 Bio-energy:

Along with the rain and snow, sunlight causes plants to grow. The organic matter that makes up those plants is known as biomass. Biomass can be used to produce electricity, transportation fuels, or chemicals.

5.4 Hydrogen

Hydrogen also can be found in many organic compounds, as well as water. But it doesn't occur naturally as a gas. It's always combined with other elements, such as with oxygen to make water. Once separated from another element, hydrogen can be burned as a fuel or converted into electricity.

5.5 Geothermal energy:

Not all renewable energy resources come from the sun. Geothermal energy taps the Earth's internal heat for a variety of uses, including electric power production, and the heating and cooling of buildings.

Methodology steps to apply new sustainable urban development

1. Cairo Vision 2050

Main Goal:

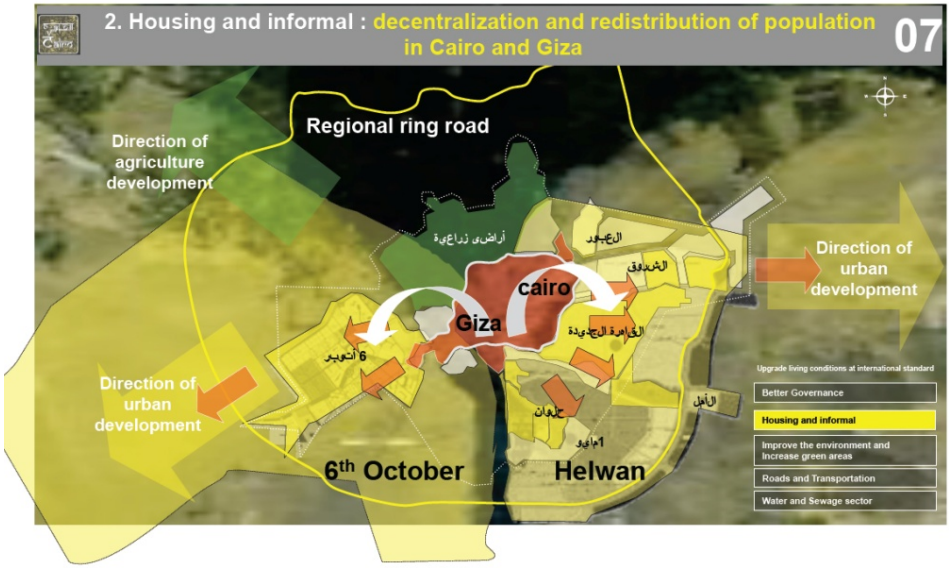
Sustainable development vision for Cairo 2050 and beyond, Includes social, cultural and economic fields integrated with urban field. With good Governance, we can achieve the best results for current and future generations. This aim includes the following items:

- Good living condition for its citizens (to be among the 30 best cities in the world).
- One of pioneer cities on the context of environmental level.
- Restoration of urban and architecture heritage of the city and elimination of slums.
- Reach the international standard for green areas/per capita.
- Containing routes for pedestrians, open and green areas and public squares.

<u>In page 33 it was mentioned the following:</u>

Road and Transportation networks connection

- Access to roads network linking Cairo suburbs to regional roads.
- Good transportation network at an international level.
- Has pedestrian and cycling network linked with the transportation network.



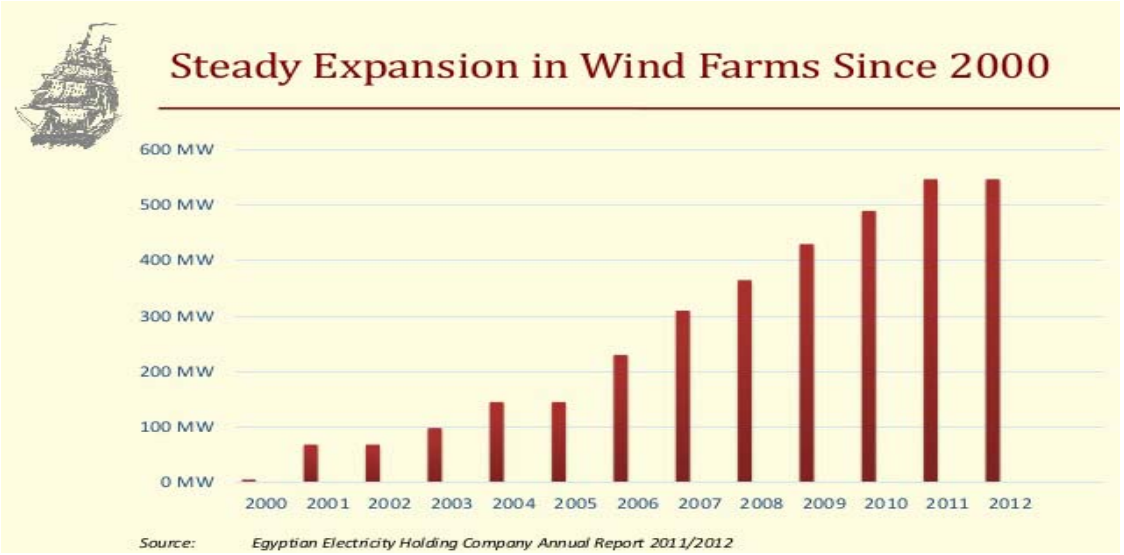
Methodology steps to apply new sustainable urban development

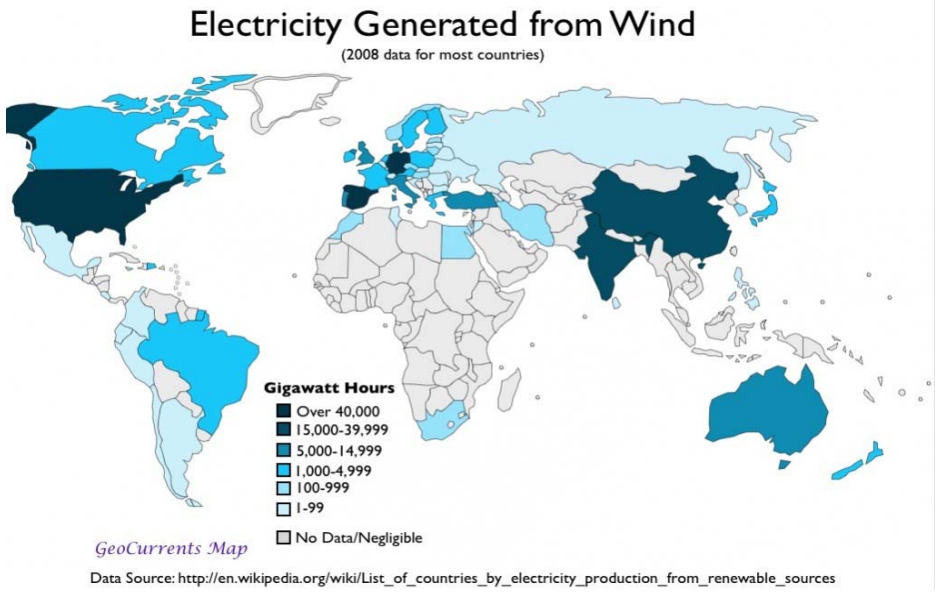
2. Renewable energy potential in Egypt:

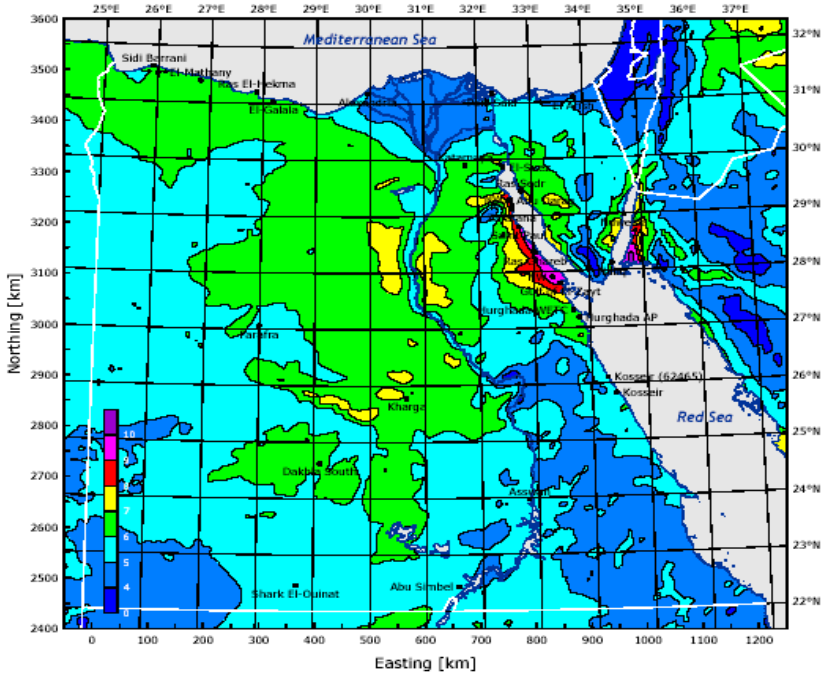
2.1 Wind power in Egypt

Egypt has some of the best wind resources in the world along the Gulf of Suez with mean wind speeds and power densities of 7-10.5 m/s and 350-900W/m2, estimated for a height of 50 m above ground level in roughness Class 1 (In comparison resources in Yemen, Syria and Jordan are modest at 7-8 m/s). Given the low density of inhabitation, the region can easily host several thousand MW of installed wind capacity. However, the above information Egypt still needs a huge efforts to can gain from this potential.

Also, there is no any regulations for urban development in areas around renewable resources to use only sustainable energy.







Methodology steps to apply new sustainable urban development

2. Renewable energy potential in Egypt:

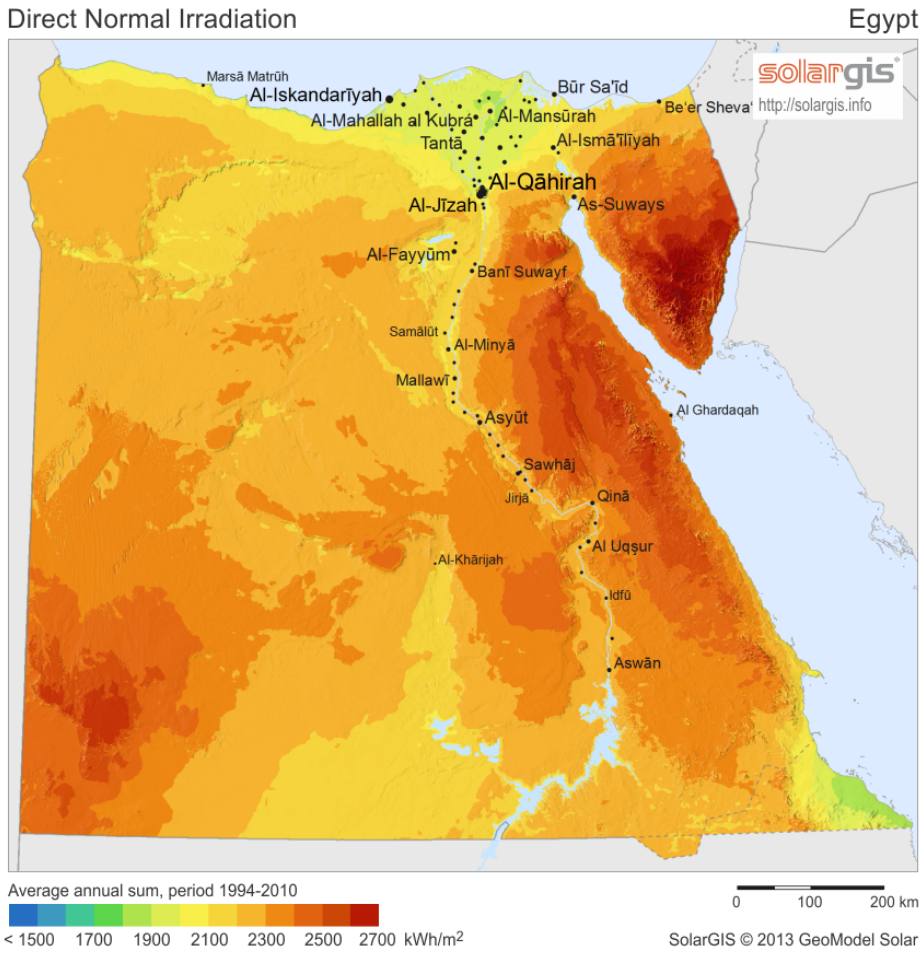
2.2 Solar Energy in Egypt

As Egypt is one of the major regions in the world blessed with high solar incidence, and as all studies have revealed that with the present rate of usage, all fossil fuel resources will be practically depleted within this century thereby stressing the need to develop cheaper sources of renewable energy of which solar applications would play an important role.

Since 1998 the only items have achieved the following:

1. Solar heating devices
2. Solar cooker
3. Solar water heating.

We can discover from the illustrated map that there are many places could be afforded by solar renewable energy. Sinai is one of the best regions in Egypt that could be served using this technique. All Red sea shore and its cities can gain a lot of clean energy from the sun. Toshka as a new urban growth can use solar energy.



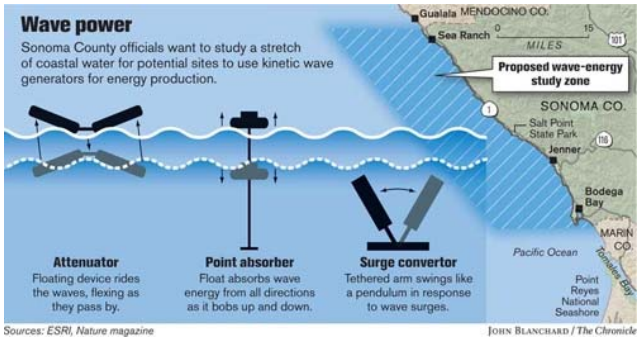
Methodology steps to apply new sustainable urban development

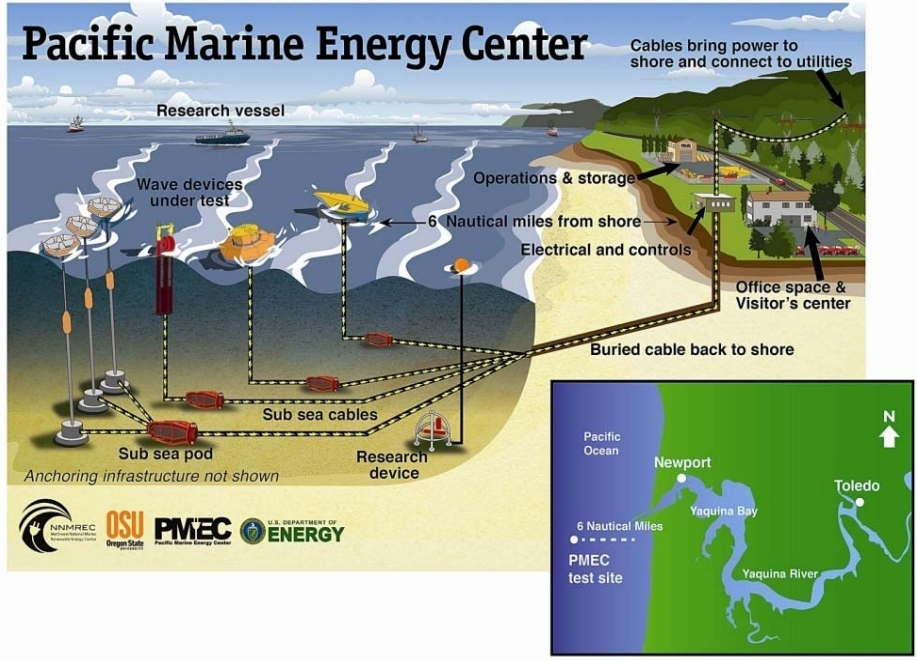
2. Renewable energy potential in Egypt:

2.3 Hydro electric power in Egypt

Egypt is producing 5% from its electrical power from clean renewable hydro electric resource which is located in the high dam as illustrated.

However Egypt has more than 3000 kilometers of sea shore. There are more than one method of using hydro electric power. The energy of the sea tides come from the gravitational pull of the moon and the sun upon the Earth. In fact, sea energy comes from a number of sources. In addition to tidal energy, there's the energy of the sea's waves, which are driven by both the tides and the winds. The sun also warms the surface of the sea more than the sea depths, creating a temperature difference that can be used as an energy source. All these forms of hydro energy can be used to produce electricity



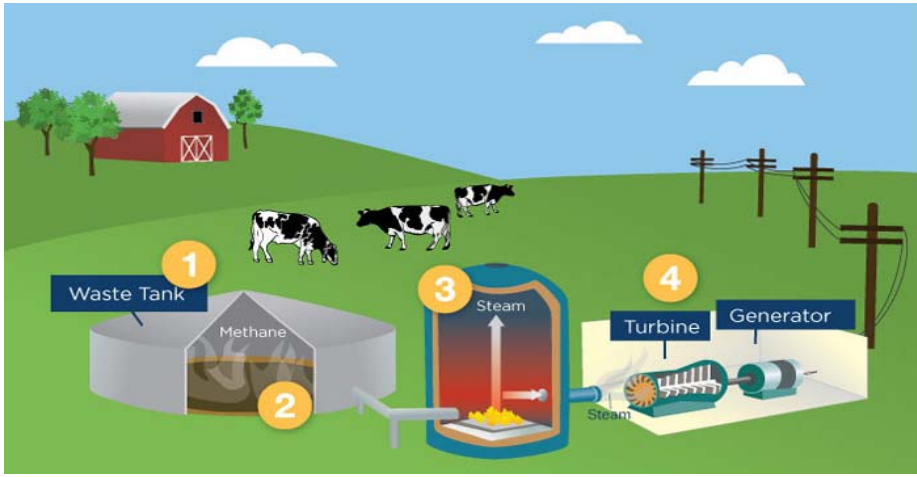


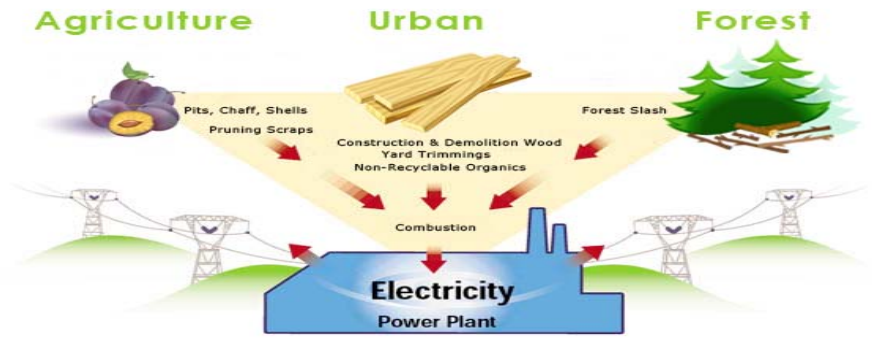
Methodology steps to apply new sustainable urban development

2. Renewable energy potential in Egypt:

2.4 Biomass-energy in Egypt

Biomass is biological material derived from living, or recently living organisms. In the context of biomass as a resource for making energy, it most often refers to plants or plant-based materials which are not used for food or feed, and are specifically called lignocellulosic biomass. As an energy source, biomass can either be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel. Conversion of biomass to biofuel can be achieved by different methods which are broadly classified into: thermal, chemical, and biochemical methods. Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and biodiesel.





Methodology steps to apply new sustainable urban development

3. Sustainable transportation:

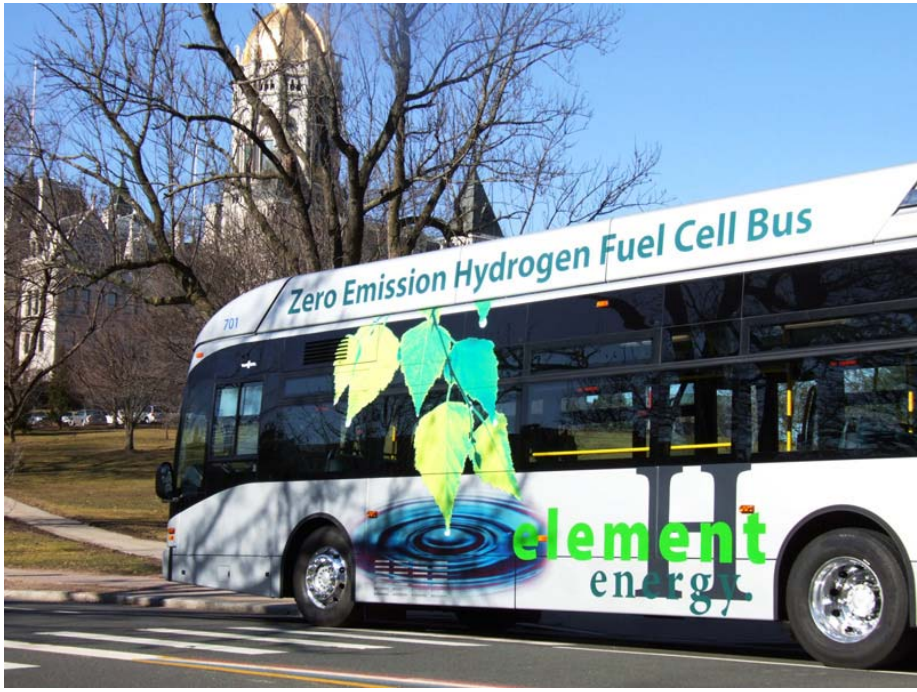
3.1 Zero emission vehicles

Green vehicles can be powered by alternative fuels and advanced vehicle technologies and include hybrid electric vehicles, plug-in hybrid electric vehicles, battery electric vehicles, compressed-air vehicles, hydrogen and fuel-cell vehicles, neat ethanol vehicles, flexible-fuel vehicles, natural gas vehicles.

Egypt can encourage the people to buy these kind of cars by canceling any taxes or customs for this kind of cars, and provide stations for car charging or alternative fuel supply.

3.2 Zero emission buses "Electric Bus"

The Zero Emission Urban Bus System, aims to be the main EU activity to extend the fully-electric solution to the core part of the urban bus network. It fits within the context of the European Commission's objective to create a competitive and sustainable transport system.



Methodology steps to apply new sustainable urban development

3. Sustainable transportation:

3.3 Installing trolleybus as sustainable transportation

Unfortunately, it was existing in Egypt covered high density district, but killed like tram lines under the plan of ending most of sustainable transportation in Egypt.

3.4 Developing bike lanes for district connection

A bikeway is a lane, route, way or path which in some manner is specifically designed and /or designated for bicycle travel. Bike lanes demarcated by a painted marking are quite common in many cities. Cycle tracks demarcated by barriers, bollards or boulevards are quite common in some European countries.

Methodology steps to apply new sustainable urban development

3. Sustainable transportation:

3.5 Installing new tram lines as sustainable transport in new traffic plan & stop demolishing old tram lines

Take into consideration old cities solutions to solve traffic problems and to move towards sustainable urban growth. Rabat in Morocco and Athens development in 2004 for Olympic games are samples. Also, the new cities which suffer from heavy and crowded traffic problems, present solution for their problem focusing on sustainable transportation.

Methodology steps to achieve Cairo's sustainable urban development

3. Sustainable transportation:

3.6 Installing Monorail for heavy traffic places

A monorail is a railway in which the track consists of a single rail, typically elevated. The term is also used to describe the beam of the system, or the vehicles traveling on such a beam or track.

Monorail vehicles often appear similar to light rail vehicles, and can be staffed or unstaffed. They can be individual rigid vehicles, articulated single units, or multiple units coupled into trains. Like other advanced rapid transit systems, monorails can be driven by linear induction motors; like conventional railways, vehicle bodies can be connected to the beam via bogies, allowing curves to be negotiated.

3.7 Developing Nile river bus (taxi) and stations and install zero carbon engines

A water taxi or a water bus, also known as a sightseeing boat, is a watercraft used to provide public or private transport, usually, but not always, in an urban environment. Service may be scheduled with multiple stops, operating in a similar manner to a bus, or on demand to many locations, operating in a similar manner to a taxi

Results and findings

كتب عادل السنهورى - هند مختار - بعثة شرم الشيخ

شهد الدكتور محمد شاكر وزير الكهرباء والطاقة المتجددة، والوزير الألمانى زجمر جابريل اليوم السبت، فى ثانى أيام المؤتمر الاقتصادى، مراسم توقيع عدة مذكرات تفاهم بين وزارة الكهرباء والطاقة المتجددة، وشركة سيمنس العالمية.

ويأتى ذلك فى إطار فعاليات مؤتمر دعم وتنمية الاقتصاد المصرى (مصر المستقبل)، الذى يعقد بمدينة شرم الشيخ.

وتشمل مذكرات التفاهم على:

- إنشاء محطة توليد كهرباء دورة مركبة فى بنى سويف بقدرة 4x 1100 ميجاوات.
- إنشاء محطات توليد كهرباء دورة مركبة فى النوبارية وسيدى كرير وجنوب القاهرة وقنا وكفر الدوار بقدرات اجمالية 6600 ميجاوات.
- إنشاء مصنع لمهمات محطات الرياح.
- إنشاء محطات المحولات بجهودها المختلفة.

وتقدر التكلفة الاستثمارية الاجمالية بحوالى 10 مليارات دولار.

وقد وقع من الجانب المصرى المهندس جابر دسوقى رئيس الشركة القابضة لكهرباء مصر، ومن الجانب الألمانى ليزا ديفيس عضو مجلس إدارة سيمنس، بحضور جوكيزر رئيس شركة سيمنس العالمية والمهندس أسامة عسران نائب وزير الكهرباء.

وسوف تسهم هذه المحطات فى إضافة قدرات جديدة لمواجهة معدات النمو الاقتصادى، وزيادة الطلب على الطاقة، مع تنفيذ استراتيجيات قطاع الكهرباء لتنوع مصادر الطاقة خلال الفترة المقبلة، وتوفيرها لجميع الاغراض، فضلاً عن توفير المزيد من فرص العمل للشباب.

كما شهد الدكتور محمد شاكر وزير الكهرباء والطاقة المتجددة، والدكتور إبراهيم العساف وزير المالية السعودى، والدكتور سلطان الجابر وزير الدولة الإماراتى، مراسم توقيع مذكرتى تفاهم بين وزارة الكهرباء والطاقة المتجددة، وشركة اكواباور السعودية وشركة مصدر الإماراتية.

ويأتى ذلك فى إطار فعاليات مؤتمر دعم وتنمية الاقتصاد المصرى (مصر المستقبل)، الذى يعقد بمدينة شرم الشيخ.

وتشمل مذكرات التفاهم على:

- مذكرة مع تحالف شركتى اكواباور السعودية ومصدر الإماراتية لتنفيذ محطة توليد كهرباء بنظام الدورة المركبة 2200 ميجاوات بغرب دمياط، ومحطات شمسية فى عدة مواقع بقدرات اجمالية 1500 ميجاوات، ومحطة رياح 500 ميجاوات، بتكلفة حوالى 2.4 مليار دولار.

- مذكرة مع شركة اكواباور السعودية لإنشاء محطة توليد كهرباء تعمل بالفحم بقدرة 2000 ميجاوات قابلة للتوسع حتى 4000 ميجاوات بتكلفة حوالى 7 مليارات دولار.

وقد وقع من الجانب المصرى المهندس جابر دسوقى رئيس الشركة القابضة لكهرباء مصر، والدكتور محمد صلاح السبكى رئيس هيئة الطاقة المتجددة، وعن شركة اكواباور محمد أبو نيان، وعن شركة مصدر الدكتور أحمد عبد الله بالهول، وذلك بحضور المهندس أسامة عسران نائب وزير الكهرباء.

وسوف يسهم هذا التعاون فى إضافة قدرات جديدة لمواجهة معدات النمو الاقتصادى، وزيادة الطلب على الطاقة، مع تنفيذ استراتيجيات قطاع الكهرباء لتنوع مصادر الطاقة خلال الفترة المقبلة، وتوفيرها لجميع الأغراض، فضلاً عن توفير المزيد من فرص العمل للشباب.

Results and findings

We can conclude from this study that we are facing five challenges that we should be careful and work on them:

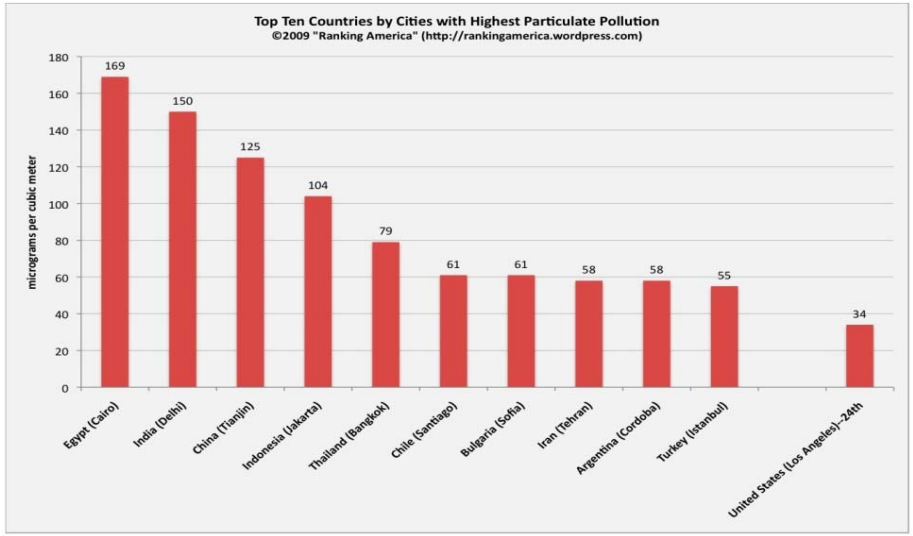
1- **Absence of long term planning:**
We can not reach to the existing situation without Absence of long term planning. We do not have vision for the next twenty and fifty years based on real analysis and numbers of all facts. The planning based on action and reaction factors always leads to failure.

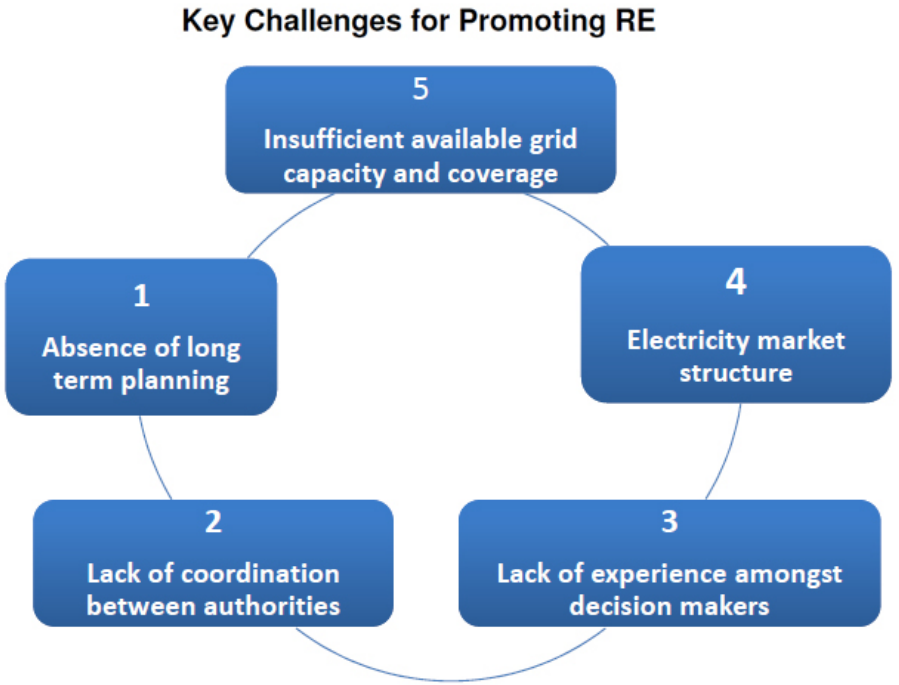
2- **Lack of coordination between authorities:**
It is very clear that some authorities in Egypt are working as separate islands. The example (which we all have seen) of after finishing the road asphalt some infra structure authorities after few weeks come to dig for its pipelines are basic principal.

3- **Lack of experience amongst decision makers:**
Without applying the philosophy of reward and punishment, decisions will be taken without any consulting.

4- **Electricity market structure:**
The electricity production and structure plan should be restudied and planned which we hope that has been done with Siemens.

5- **Insufficient available grid capacity and coverage:**
The electricity production and structure plan should be restudied and planned which we hope that has been done with Siemens.





Results and findings

More than 80% out of a population that has exceeded 90 million currently live in Egypt's slums, most of which are based in the Greater Cairo metropolitan area.

Inhabitants are forced to live in inhumane settlements, owing to a severe shortage of affordable housing in the cities, suffer from lack of electricity and sewage services, and are subjected to mistreatment by the state, including regular forced evictions.

Thousands of poor Egyptians who survive in slum areas are left on their own to deal with extreme heat in the summer or treacherous rain stints in the winter, such as a recent storm that drenched shanty towns across the country.

The ever-growing number of slum dwellers highlights the huge disparity in the distribution of wealth, residential units, and unequal access to housing options.

"Governmental policies since the 1970s have always been biased to big capital and profit accumulation rather than the society's lower tranches. Governments literally ignored informal housing; it was never their priority," Khaled Ali, a prominent labor lawyer and former presidential candidate.

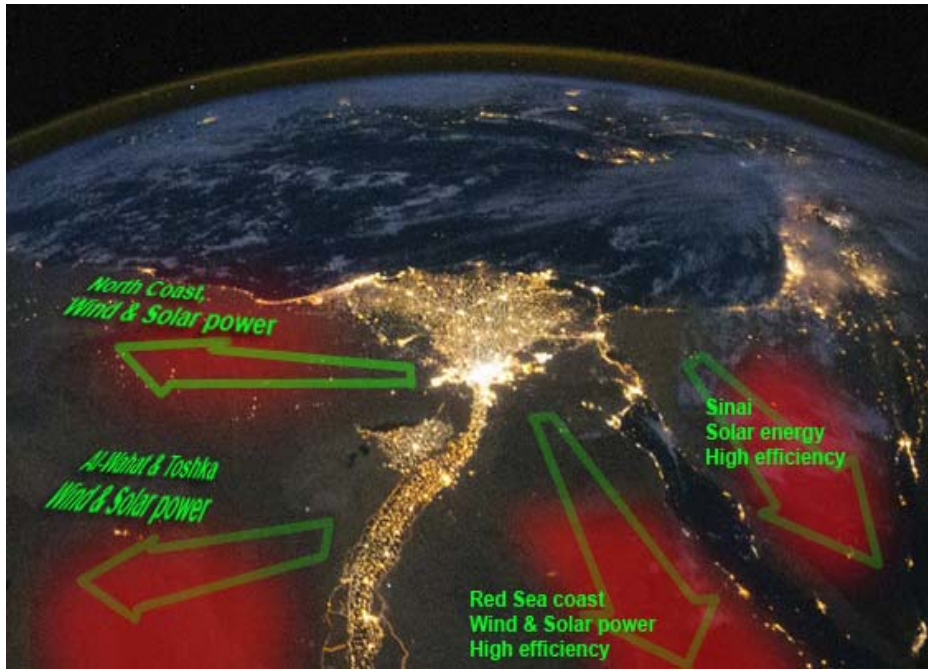
Results and findings

The illustrated figure clarify the actual situation of urban growth in Egypt. It is very clear that all urban growth in Egypt is focused on only one item which is agriculture around Nile river which was the main criteria of historical urban growth all over Egypt as it has a logic because the agriculture was the main pillar of Egyptian economy.

But, nowadays and after the overpopulation expanding and the vision of creating an industrial country and opening a new approaches for urban growth, the potential of generating renewable energy should be the main principal for the new urban growth.

To achieve a real sustainable growth, we have to be careful of the main pillars of sustainability which are environment, people and economy. In other words we have to study the whole country as potential locations of having renewable resources of energy and water. They will be the base of strong economy based on agriculture and industry to create the new cities.

From all previous studies we can conclude that north coast, Al-Wahat, Toshka, Red sea coast and all Sinai are empty areas with an excellent value for renewable energy and water.

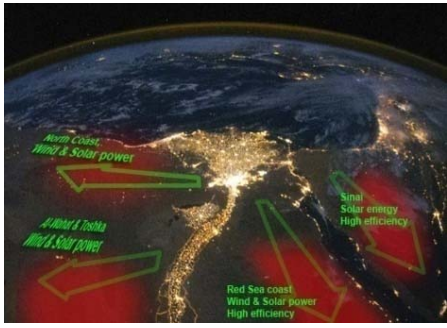


Discussion and analysis

- The Sustainable urban development is created in a long term planning. So, we should back again to planning stages for long terms and to be divided into short stages (five years for example) to can face our serious challenges.
- Sustainable development is the only way to create our grandsons future.
- Electricity production is increasing all over the world and Egypt should start and according to its resources it could be on of clean energy exporters.

Conclusion and recommendations

- Long term planning such as Cairo vision 2050 should be studied by governmental authorities with corporation of academic and research staff of the country.
- Opening of sustainable urban growth based on potentials of renewable energy production will create new era for Egypt economy and social living.
- Sinai, North Coast, Al-Wahat, Toshka, and Red Sea coast are the main directions of new urban development.
- Transportation is best way for developing new urban areas as a result of historical new areas such as Heliopolis and Nasr city.
- Using all means of sustainable transportation which are; tram, trolleybus, monorail, underground metro, zero emission buses, environmental friendly cars, river taxi, bikes, and side walks.
- Demolishing tram lines was a big mistake for Cairo.
- Publishing the data and results of long term planning will help researchers to provide ideas for better enhancement of this entire vision.
- Apply the sustainable rating system and pushing all designers and developers to build upon its recommendations will push Egyptian projects towards better environment.
- Eliminate any taxes or customs on environmental-friendly vehicles and cars and provide refill stations for those new tools.



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Thank you,

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