

Present and Future of Global Energy Sources

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Abstract

The world's energy sources can be broadly divided into three categories; fossil, nuclear and renewable fuel sources. The proven fossil energy reserve at present is around 36×10^{21} Joules and it is the prime source of energy in today's world. Sun, wind and water are perfect energy sources, depending on where we are. Those are non-polluting, renewable, efficient, simple and readily available. The acceleration of technological development has opened the door to continuous and rapid worldwide economic growth and has in fact allowed the world to achieve energy sustainability using many different energy sources. Annual GDP and Energy Consumption of least and developing countries and region are increasing exponentially. On the other hand, annual GDP and Energy Consumption of developed and rich countries and region are increasing linearly. The Earth, the Sun, the Galaxy and the Universe have more than enough energy resources to power our civilization for the following decades, centuries and millennia. The future sources of energy should be renewable for our environmental balance and better globe.

Keywords: Renewable; Solar; Biomass; Fissile; Tidal; Hydroelectric

Introduction

Without energy, life does not exist [1]. In 2020, world population will be grown to 8 billion people, the global economy is approaching \$80 trillion, and the wireless Internet is now connecting almost half of humanity. Synergies among nanotechnology, biotechnology, information technology, and cognitive science have dramatically improved the human condition by increasing the availability of energy, food, and water and by connecting people and information anywhere, anytime [2]. The positive effects are to increase collective intelligence and to create value and efficiency while lowering costs. The acceleration of technological development has opened the door to continuous and rapid worldwide economic growth and has in fact allowed the world to achieve energy sustainability using many different energy sources. However in this paper I shall briefly discuss on sources of energy, amount of present energy, comparative steady of renewable and non-renewable energy, global annual energy Consumption pattern in respect of annual GDP and ultimate sources of energy for future.

Sources of Energy

All forms of life extract energy from the environment and convert it to forms which can be used. The world's energy sources can be broadly divided into three categories; such as, fossil fuel, nuclear fuel and renewable fuel sources. Brief energy sources have been shown in Table 1. The estimates for the amount of energy in these resources is usually define in Zetta-Joules (ZJ), where $1 \text{ ZJ} = 10^{21}$ joules. Worldwide energy sources in percentage (in year 2004) have been shown in Figure 1 [3]. The proven fossil energy reserves of end of the year 2009 were 36 ZJ (coal 19.8 ZJ+ oil 8.1ZJ + gas 8.1ZJ). However, the real reserves may be up to a factor 4 larger [4].

Renewable Energy

Renewable energy is energy which is generated from natural sources i.e. sunlight, wind, rain, tides, geothermal heat and can be generated again and again as and when required. They are renewable because they are naturally replenished at a constant rate. Renewable energy is available in plenty and by far most the cleanest sources of energy available on this planet [5]. About 16% of global final energy consumption comes from renewable, with 10% coming from traditional biomass, which is mainly used for heating, and 3.4% from hydroelectricity. New renewable (small hydro, modern biomass, wind, solar, geothermal, and bio-fuels) accounted for another 3% and are growing very rapidly [6]. There are

few advantages and challenges of using renewable sources of energy and that has been discussed briefly in next couple of paragraphs.

Advantages of Renewable Energy

There are few advantages of using renewable sources of energy and those are briefly narrated below.

- The sun, wind, geothermal, ocean energy are available in the abundant quantity and free.
- The non-renewable sources of energy that we are using are limited and are bound to expire one day.
- Renewable sources have low carbon emissions, therefore they are considered as green and environment friendly.
- Renewable helps in stimulating the economy and creating job opportunities. The money that is used to build these plants can provide jobs to thousands to millions of people.
- We don't have to rely on any third country for the supply of renewable sources as in case of non-renewable sources.
- Renewable sources can cost less than consuming the local electrical supply. In the long run, the prices of electricity are expected to soar since they are based on the prices of crude oil, so renewable sources can cut your electricity bills.
- Various tax incentives in the form of tax waivers, credit deductions are available for individuals and businesses who want to go green.
- Solar energy is renewable, non-polluting and relatively maintenance free.
- Wave and tide is a non-polluting source of energy. Wave turbines are relatively quiet to operate and do not affect wildlife.

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1. Fossil Fuel					
a. Coal	b. Oil	c. Gas			
2. Nuclear Fuel					
a. Nuclear Fuel	b. Nuclear Fusion				
3. Renewable Fuel Sources					
a. Solar Energy	b. Wind Power	c. Wave and Tidal Power	d. Geothermal	e. Biomass	f. Hydropower

Table 1:Worldwide energy sources in broad categories.

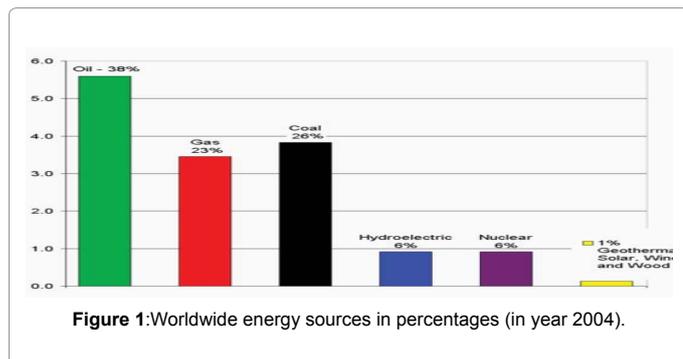


Figure 1:Worldwide energy sources in percentages (in year 2004).

Challenges of Renewable Energy

There are few challenges of using renewable sources of energy and those are briefly narrated below.

- It is not easy to set up a plant as the initial costs are quite steep.
- Solar energy can be used during the day time and not during night or rainy season.
- Geothermal energy which can be used to generate electricity has side effects too. It can bring toxic chemicals beneath the earth surface onto the top and can create environmental changes.
- Hydroelectric provide pure form of energy but building dams across the river which is quite expensive can affect natural flow and affect wildlife.
- To use wind energy, we have to rely on strong winds therefore we need to choose suitable site to operate them.
- There is less available solar energy in areas near the poles of the Earth. Cloud cover can reduce efficiency. PV cells are still quite expensive.
- The wave and tide turbines can be unsightly. Wave heights vary considerably, so they would not produce a constant supply of energy.

Non-Renewable Energy

Non-Renewable energy is energy which is taken from the sources that are available on the earth in limited quantity and will vanish fifty-sixty years from now. Non-renewable sources are not environmental friendly and can have serious affect on our health [7]. They are called non-renewable because they cannot be re-generated within a short span of time. Non-renewable sources exist in the form of fossil fuels, natural gas, oil and coal. There are few advantages and challenges of using non-renewable sources of energy and that has been discussed briefly in next couple of paragraphs.

Advantages of Non-renewable Energy

There are few advantages of using non-renewable sources of energy and those are briefly narrated below:

- Non-renewable sources are cheap and easy to use. We can easily fill up our car tank and power our motor vehicle.
- We can use small amount of nuclear energy to produce large amount of power.
- Non-renewable have little or no competition at all. For example, if we are driving a battery driven car our battery gets discharged then we won't be able to charge it in the middle if the road rather it is easy to find a gas pumping station.
- They are considered as cheap when converting from one type of energy to another.

Challenges of Non-renewable Energy

There are few challenges of using non-renewable sources of energy and those are briefly narrated below.

- Non-renewable sources will expire some day and we have to use our endangered resources to create more non-renewable sources of energy.
- The speed at which such resources are being utilized can have serious environmental changes.
- Non-renewable sources release toxic gases in the air when burnt which are the major cause for global warming.
- Since these sources are going to expire soon, prices of these sources are soaring day by day.

Method of Estimation of Global Energy Consumption up to the Year of 2030

Global region-wise data for annual GDP and Energy Consumption has been collected from available sources and web sites [8]. All the available data was found up to the year of 2006. On the basis of previous recorded GDP (from 1990 to 2006) future annual GDP has been calculated up to the year of 2030 [9]. Based on that projected GDP (from 2006-2030), future Energy Consumption has been calculated up to the year of 2030. From the trend (1990-2006) of Energy Consumption, average Energy Consumption has been calculated [10]. And found a constant Energy Consumption (EC) values. This constant value is added with the previous successive years EC to get next year Energy Consumption (EC) up to the year of 2030. So, annual GDP and Energy Consumption up to 2030 have been estimated on the basis of collected data and trend analysis.

Finding

Analysis and finding of trend of average increment of GDP and

energy consumption of world has been summarized below.

a. Trend of average increment of GDP and Energy Consumption of Bangladesh has been shown on the Figure 2. GDP of Bangladesh is increasing exponentially.

b. Energy Consumption of Asia or SAARC is increasing exponentially as shown in Figure 2. It's true that, GDP of developing countries are increasing exponentially. Whereas GDP of North America or Japan Australian region is increasing linearly. So GDP of developed countries are increasing linearly.

c. Trend of average increment of GDP and Energy Consumption in SAARC has been shown in Figure 3. Annual GDP and Energy Consumption of SAARC region are increasing exponentially.

d. Trend of average increment of GDP and Energy Consumption in African region has been shown in Figure 4. Annual GDP and Energy Consumption of African region is increasing exponentially.

e. Trend of average increment of GDP and Energy Consumption in Europe region has been shown in Figure 5. Energy Consumption of European region is increasing linearly.

f. Trend of average increment of GDP and Energy Consumption in Japan, South Korea, New-Zealand and Australian region has been shown in Figure 6. Energy Consumption of Japan, South Korea, New-Zealand and Australian region is increasing linearly.

g. Trend of average increment of GDP and Energy Consumption in North American region has been shown in Figure 7. GDP and Energy Consumption of North American region is increasing linearly.

h. Trend of average increment of GDP and Energy Consumption in Middle East region has been shown in Figure 8. Annual GDP and Energy Consumption of Middle East region are increasing exponentially.

Economic Growth and Energy

Due to the accelerated growth of many developing nations, led first by China and later by India, global economic growth has increased 4% annually on average during the first two decades of the 21st century. From 2000 to 2020, energy demand and supply have grown by 2% annually, which means a compounded growth of almost 50% during the last two decades. This indicates a very healthy expansion of the power sector and a sustained increase in energy efficiency. World economy is headed for more growth in the following years. Such growth will particularly benefit the poorer people still without any access to electricity, which has fallen from close to 2 billion in 2000 to just over 1 billion in 2020, and electricity might actually reach everybody in the planet by the year 2040. World GDP growth of 4%, due to continuous rise of China and now also India, is spreading to even poorer parts of the world. Additionally, energy intensity continued to decline, that is, the amount of energy required to produce a dollar (dinar, euro, pound, ruble, rupee, yen or yuan) of GDP. In other words, energy efficiency is increasing and less energy is needed to produce more, particularly now that so many nations are moving from industrial to post-industrial societies. Furthermore, poorer countries have been growing faster than richer countries and the economic stability is paving the road for continuous growth around the world [11]. Fossil fuels still represent over 80% of total energy supplies today, in 2020, but the trend towards new energy sources is clear in the future. Coal production has basically remained stable between 2000 and 2020. China is still the largest producer and consumer of coal, but forecasts indicate a future decline

in power plants, regardless of the existing huge coal reserves for almost two centuries [12]. Now world is declining towards renewable and other energy sources.

Why should We Conserve Energy?

Energy needs to be conserved to protect our environment from drastic changes; to save the depleting resources for our future generations. The rate at which the energy is being produced and consumed can damage our world in many ways. In other words, it helps us to save the environment. We can reduce those impacts by consuming less energy. The cost of energy is rising every year. It is important for us to realize how energy is useful to us and how can we avoid it getting wasted [13]. To start saving energy is not a big thing at all. We can start saving the energy from our home itself, just by turning off the lights during day hours, washing clothes in cold water or using public transport instead of using our own vehicle and later can implement these things on much wider scale at society level, then at city level then district level and finally at country level. You might notice a small change in your monthly bills by implementing these changes as they would be getting decreased more and more. With so many alternatives and so many techniques about there, if millions of people like us start doing these things, it will help us to save much more money and also help the environment.

The Ultimate Source of Energy for Future

Actually Sun, wind and water are perfect energy sources, depending on where we are. Those are non-polluting, renewable and efficient. Those are simple and readily available. Those are not only do the uses of renewable energy sources help reduce global carbon dioxide emissions, but also add some much-needed flexibility to the energy resource mix by decreasing our dependence on limited reserves of fossil fuels energy sources [14]. It is interesting that, these renewable energy sources create their own energy. The object is to capture and harness their mechanical power and convert it to electricity in the most effective and productive manner possible. Almighty create such balance that, there is more than enough renewable energy sources to supply all of the world's energy needs forever. However, the challenge is to develop the capability to effectively and economically capture, store and use those energy when needed. The sun provides enough energy that can be stored for use long after the sun sets and even during extended cloudy periods. But making it available is much easier said than done. It would be cost prohibitive to make solar energy mainstream for major world consumption in the near future [17]. The technology is good-looking much ready for many business and consumer applications, but it would be way too expensive to replace the current energy infrastructure used for fossil fuel energy. According to the European Photovoltaic Industry Association, solar power could provide energy for more than one billion people by 2020 and 26 percent of global energy needs by 2040 [15].

On the other hand, wind and hydroelectric power, which have been used effectively for generations, are also rapidly growing energy markets. The principle behind both is that the forces of the wind and water currents are passed through turbines which convert their energy into electricity. Commercial wind energy is usually collected by wind "farms" essentially consisting of hundreds of wind turbines (windmills) spread over large plots of land, usually coastal area. But hydroelectric power is harnessed in several different methods. The most popular is through dams, such as the three Georges Dam on the Yangtze River in China [16]. The Three Gorges Dam is the world's largest power station in terms of installed capacity (22,500 MW). Again, second form of hydroelectric energy is tidal power. In use since the early 1900s, tidal

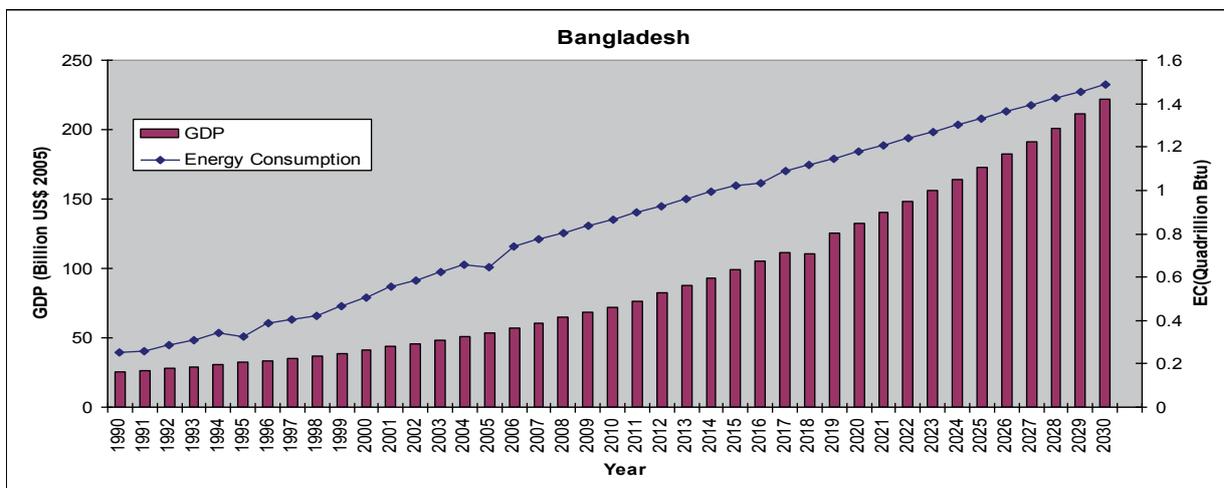


Figure 2: Trend of average increment of GDP and Energy Consumption in Bangladesh.

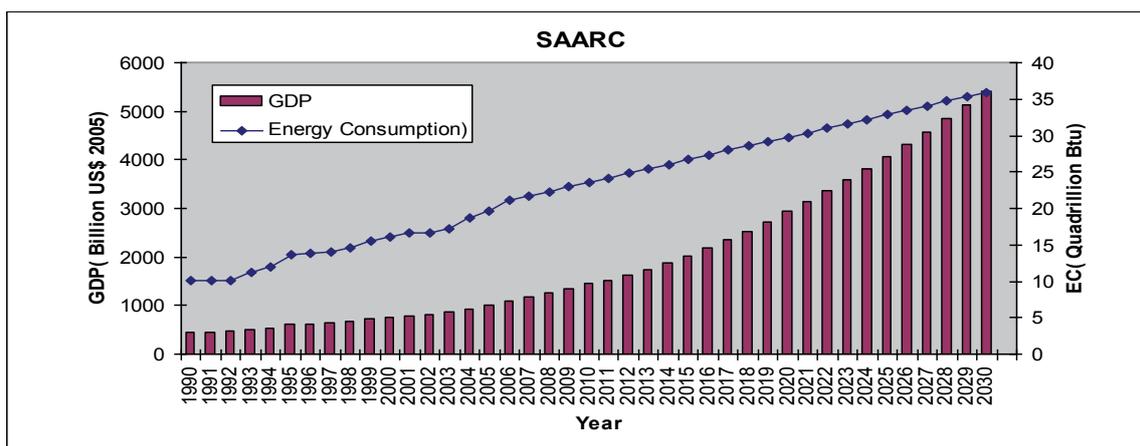


Figure 3: Trend of average increment of GDP and Energy Consumption in SAARC.

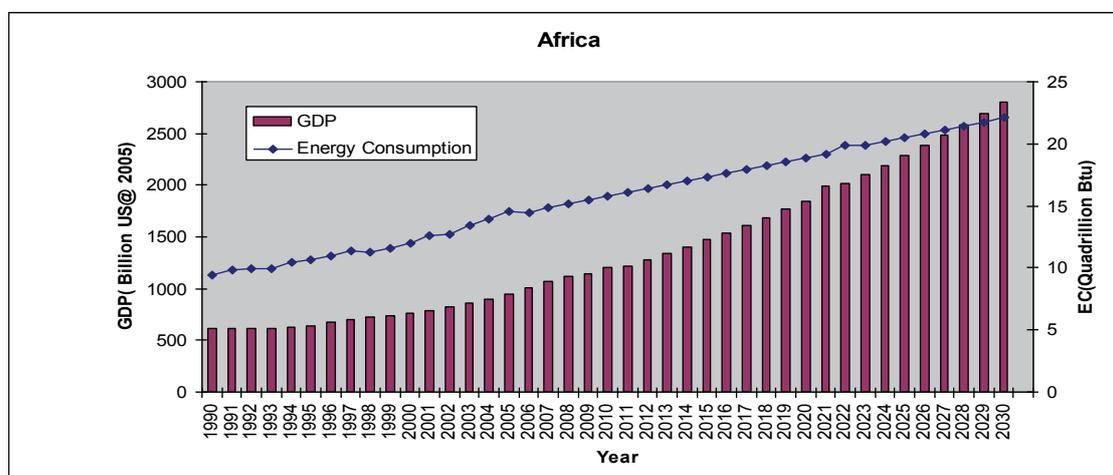


Figure 4: Trend of average increment of GDP and Energy Consumption in Africa.

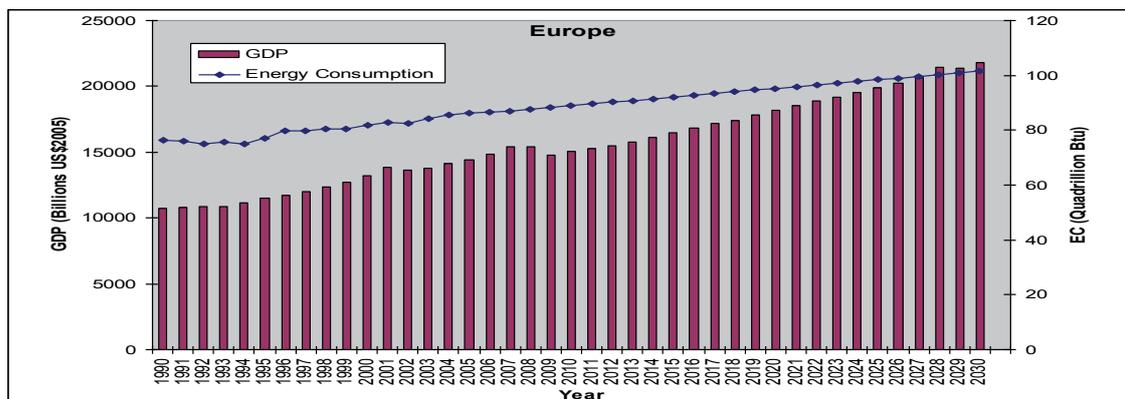


Figure 5: Trend of average increment of GDP and Energy Consumption in Europe.

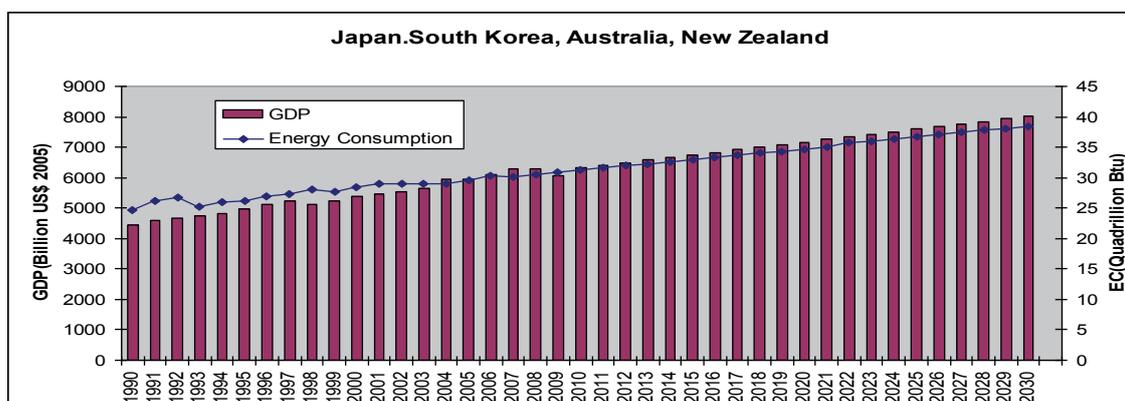


Figure 6: Trend of average increment of GDP and Energy Consumption in Japan, South Korea, Australia & New-Zealand.

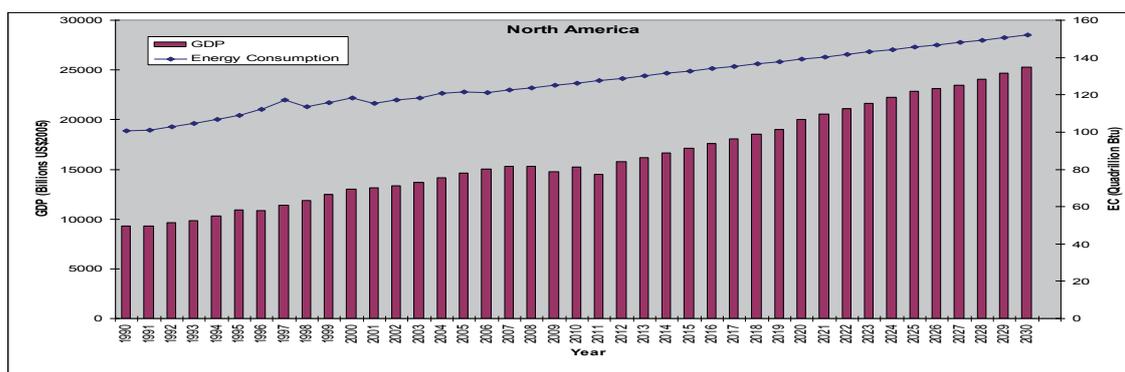


Figure 7: Trend of average increment of GDP and Energy Consumption in North America.

power stations collect the energy created by the rise and fall of the tides to convert to electricity. Biomass energy, or energy from burning plants and other organic matter, is one of man's earliest sources of energy [17]. Wood was once the main source of power for heat, and it still is in many developing countries. Most people in developed countries use wood

only for aesthetic purposes or secondary heating, limited mainly to fireplaces and decorative woodstoves. Roughly one to two billion people in the developing nations still use wood as their primary source of heat. It is this group that is seen being among the first to convert to solar heating and energy because there is no other existing infrastructure to

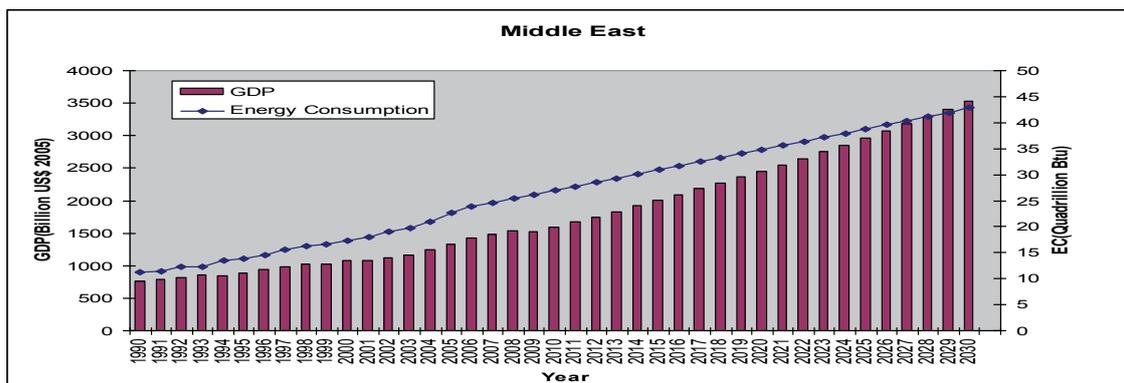


Figure 8: Trend of average increment of GDP and Energy Consumption in Middle East.



Figure 9: Picture of Solar, Wind and Hydroelectric Power Plant.



Figure 10: Picture of Tidal and Biomass Power Plant.

hinder its development. Few pictures of solar, wind, hydroelectric, tidal and biomass power plants have been shown in Figures 9 and 10 below. So for our environmental balance the ultimate sources of energy will be renewable.

Conclusion

Annual GDP and Energy Consumption of least and developing countries and region are increasing exponentially. On the other hand, annual GDP and Energy Consumption of developed and rich countries and region are increasing linearly. The Earth, the Sun, the Galaxy and the Universe have more than enough energy resources to power our civilization for the following decades, centuries and millennia. With enough technology, it is basically a matter of costs and priorities.

Converting the energy resources into available supplies can be done, but it will certainly take massive investments and lots of imagination, creativity, science and engineering. All resources are obviously finite, but some are almost potentially inexhaustible even with an accelerating population and rapid technological consumption. Methane hydrate, hydrogen, helium, nuclear fusion, solar, wind, tidal, mass-energy conversion and antimatter fuels are all eventually possible. Our civilization is still in its infancy, and barring any wild cards, geopolitical crisis, environmental disasters or extraterrestrial contacts, technology will keep pushing off the limits to growth. So for our environmental balance and better globe the future sources of energy should be renewable.

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