

# ***BOLT***



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# *Introduction*

No doubt that Egypt that faces numerous problems that represent great challenges for our beloved country. These problems vary widely nearly in all fields in the daily life known as Egypt grand challenges like health, industrial, pollution, environmental, social, and economic problems. and stop the government from developing itself, making it considered one among the developing countries despite having the elemental factors alongside the acceptable human, natural and artificial resources giving it countless chances to stay up with the planet daily developing and provides it opportunities to steer the planet, so solving these challenges must be as fast and final as we will, there are about eleven grand challenges that force Egypt and that we are getting to discuss below.



Fig (1)

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# **Egypt Grand Challenges**

- 1- *Improve the use of alternative energies.*
  - 2- *Reduce and adapt to the effect of climatic change.*
  - 3- *Deal with population growth and its consequences.*
  - 4- *Improve the scientific and technological environment for all.*
- 

- *Improve the use of alternative energies.*

Improving the use of other energies has become the main goal of the planet. BP and Royal Dutch Shell, two of the world's largest oil companies, released their report on global energy needs in the long term. In their report, they explain that global climate change, increase, and fuel depletion mean that renewable energy will be the primary and only energy solution in the long term.

A variety of renewable energy sources suitable for use in Egyptian conditions such as Hydropower, wind energy and solar energy. (National Strategy for Science, Technology, and Innovation 2030,2019)



Fig (2)

### **Hydropower: -**

Hydropower plays an important role in generating electricity in Egypt. Projects such as the Aswan High Dam produce about 15,300 giga watt hours per year, or roughly 5 to 10% of Egypt's annual energy needs. (National Strategy for Science, Technology, and Innovation 2030,2019)

### **Wind Energy: -**

Wind power has long been a popular source of renewable energy in many developed countries of Europe. The most developed wind region in Egypt is Zofran, with an average wind speed of 9 meters / second. The project consists of a series of wind farms. (National Strategy for Science, Technology, and Innovation 2030,2019)

### **Solar Energy: -**

Egypt's production of radiation ranges between 2000 to 3200 kilowatt hours per square meter annually, which gives it great potential to use this type of renewable energy. (National Strategy for Science, Technology, and Innovation 2030,2019)

### **Effects of using alternative energies in Egypt: -**

1. Reducing environmental pollution resulting from non-renewable sources.

Reducing the percentage as these projects will provide job opportunities for all youth. (National Strategy for Science, Technology, and Innovation 2030,2019)

## *Reduce and adapt to the effect of climatic change.*

Most climate scientists agree the main cause of the current global warming trend is human expansion of the "greenhouse effect"<sup>1</sup>



Fig (3)

— warming that results when the atmosphere traps heat radiating from Earth toward space.

Certain gases in the atmosphere block heat from escaping. Long-lived gases that remain semi permanently in the atmosphere and do not respond physically or chemically to changes in temperature are described as "forcing" climate change. Gases, such as water vapor, which respond physically or chemically to changes in temperature are seen as "feedbacks."

Gases that contribute to the greenhouse effect include:

Water vapor. The most abundant greenhouse gas, but importantly, it acts as a feedback to the climate. Water vapor increases as the Earth's atmosphere warms, but so does the possibility of clouds and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect.

Carbon dioxide (CO<sub>2</sub>). A minor but very important component of the atmosphere, carbon dioxide is released through natural processes such as respiration and



volcano eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels.

Humans have increased atmospheric CO<sub>2</sub> concentration by more than a third since the Industrial Revolution began. This is the most important long-lived "forcing" of climate change.

**Methane.** A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. On a molecule-for-molecule basis, methane is a far more active greenhouse gas than carbon dioxide, but also one which is much less abundant in the atmosphere.

**Nitrous oxide.** A powerful greenhouse gas produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

**Chlorofluorocarbons (CFCs).** Synthetic compounds entirely of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. They are also greenhouse gases. In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change, a group of 1,300 independent scientific experts from countries all over the world under the auspices of the United Nations, concluded there's a more than 95 percent probability that human activities over the past 50 years have warmed our planet. The industrial activities that our modern civilization depends upon have raised atmospheric carbon dioxide levels from 280 parts per million to 400 parts per million in the last 150 years.

The panel also concluded there's a better than 95 percent probability that human-produced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused much of the observed increase in Earth's temperatures over the past 50 years.

Global warming is primarily a problem of too much carbon dioxide (CO<sub>2</sub>) in the atmosphere—which acts as a blanket, trapping heat and warming the planet. As we burn fossil fuels like coal, oil and natural gas for energy or cut down and burn forests to create pastures and plantations, carbon accumulates and overloads our atmosphere. Certain waste management and agricultural practices aggravate the problem by releasing other potent global warming gases, such as methane and

nitrous oxide. See the pie chart for a breakdown of heat-trapping global warming emissions by economic sector.

- ***DEAL with Population growth and its consequence***

In biology or human geography, population growth is the increase in the number of individuals in a population. Global human population growth amounts to around 83 million annually or 1.1% per year. The global population has grown from 1 billion in 1800 to 8 billion in November 2022. It is expected to keep growing. (Ritchie,2023)

(As figure)

| Population   |       |         |
|--------------|-------|---------|
| Years passed | Year  | Billion |
| —            | 1800  | 1       |
| 127          | 1927  | 2       |
| 33           | 1960  | 3       |
| 14           | 1974  | 4       |
| 13           | 1987  | 5       |
| 12           | 1999  | 6       |
| 12           | 2011  | 7       |
| 12           | 2023* | 8       |
| 14           | 2037* | 9       |
| 18           | 2055* | 10      |
| 33           | 2088* | 11      |

Fig (4)

### **-History of population growth around the world**

The world population has been rising continuously since the end of the Black Death, around the year 1350. The population began growing rapidly in the western world during the industrial revolution. The most significant increase in the world's population has been since the 1950s, mainly due to medical advancements and increase in agricultural productivity. (As figure)



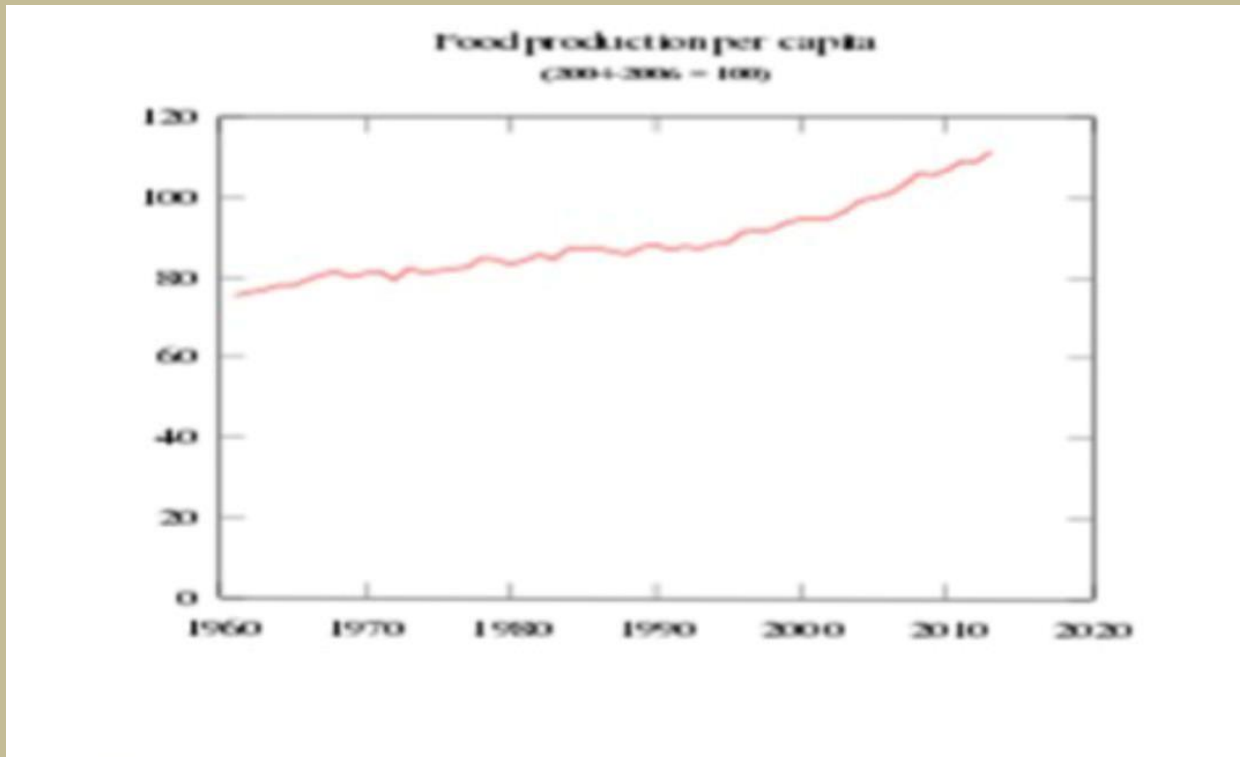


Fig (5)

### **-Population Growth Rate**

Surely "The population growth rate" is the rate at which the number of individuals in a population increases in a given time period, expressed as a fraction of the initial population. Specifically, population growth rate refers to the change in population over a unit time period, often expressed as a percentage of the number of individuals in the population at the beginning of that period

### **-Population Growth by county**

Many of the world's countries, including many in Sub-Saharan Africa, the Middle East, South Asia, and South East Asia, have seen a sharp rise in population since the end of the Cold War. The fear is that high population numbers are putting further strain on natural resources, food supplies, fuel supplies, employment, housing, etc. in some of the less fortunate countries. For example, the population of Chad has ultimately grown from 6,279,921 in 1993 to 10,329,208 in 2009, further straining its resources.

Vietnam, Mexico, Nigeria, Egypt, Ethiopia, and the DRC are witnessing a similar growth in population (As figure)

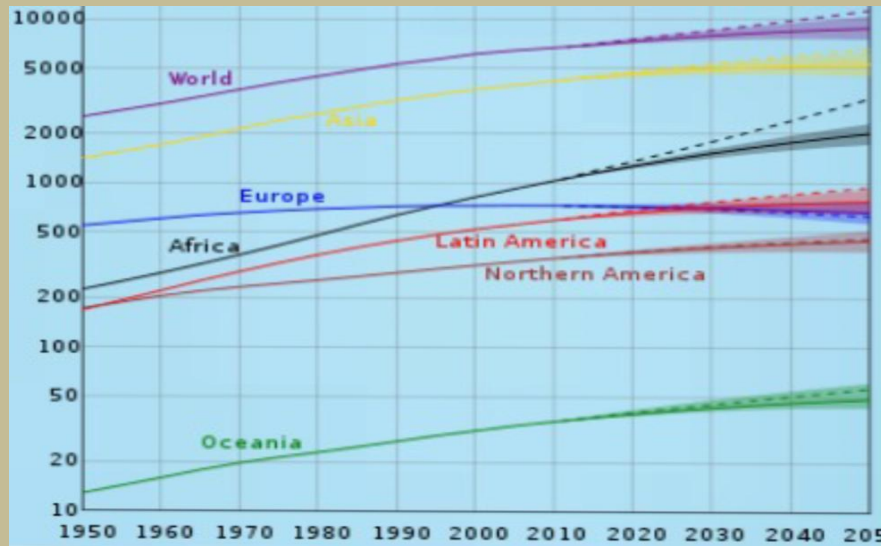


Fig (6)

The majority of world population growth today is occurring in less developed countries.

### **-Causes of Over population**

1-Decline in the Death Rate: At the root of overpopulation is the difference between the overall birth rate and death rate in populations. If the number of children born each year equals the number of adults that die, then the population will stabilize. Talking about overpopulation shows that while there are many factors that can increase the death rate for short periods of time, the ones that increase the birth rate do so over a long period of time. The discovery of agriculture by our ancestors was one factor that provided them with the ability to sustain their nutrition without hunting. This created the first imbalance between the two rates.

2- Better Medical Facilities: Following this came the industrial revolution. Technological advancement was perhaps the biggest reason why the balance has been permanently disturbed. Science was able to produce better means of producing food, which allowed families to feed more mouths. Medical science made many discoveries thanks to which they were able to defeat a whole range of diseases. Illnesses that had claimed thousands of lives till now were cured because of the invention of vaccines.

Combining the increase in food supply with fewer means of mortality tipped the balance and became the starting point of overpopulation.

3- More Hands to Overcome Poverty: However, when talking about overpopulation we should understand that there is a psychological component as well. For thousands of years, a very small part of the population had enough money to live in comfort. The rest faced poverty and would give birth to large families to make up for the high infant mortality rate. Families that have been through poverty, natural disasters, or are simply in need of more hands to work are a major factor for overpopulation. As compared to earlier times, most of these extra children survive and consume resources that are not sufficient.

4- Technological Advancement in Fertility Treatment: With the latest technological advancement and more discoveries in medical science, it has become possible for couples who are unable to conceive to undergo fertility treatment methods and have their own babies. Today there are effective medicines that can increase the chance of conception and lead to a rise in the birth rate. Moreover, due to modern techniques pregnancies today are far safer.

Immigration: Many people prefer to move to developed countries like the US, UK, Canada, and Australia where the best facilities are available in terms of medical, education, security, and employment. The end result is that those people settle over there and those places become overcrowded.

Difference between the number of people who are leaving the country and the number of people who enter narrows down which leads to more demand for food, clothes, energy, and homes. This gives rise to a shortage of resources. Though the overall population remains the same, it just affects the density of the population making that place simply overcrowded. Lack of Family Planning: Most developing nations have a large number of people who are illiterate, live below the poverty line, and have little or no knowledge about family planning. Getting their children married at an early age increase the chances of producing more kids. Those people are unable to understand the harmful effects of overpopulation and lack of quality education prompts them to avoid family planning measures.

### **-Positive effects of Overpopulation**

1. Defence: Large Population makes it possible to mobilize enough people to defend the integrity of the country in times of war and any other emergencies.
2. Increase in Labor Market: Increasing population ensures an increase in the labor force. Lack of growth in the labor force will make a country static, retarded, and gets to equilibrium at less than the full employment level of the economy.
3. Large Market: Investors would like to invest in a country with a large population. As the population continues to grow so will be the growth in demand for food, shelter, clothing, etc.

### **-Negative Effects of Overpopulation**

1. Poverty: As a result of overpopulation, the available resources would not be able to do round, and this will result in poverty in the country.
2. Unemployment: Overpopulation leads to unemployment; this is as a result of the number of people looking for jobs outruns available resources.
3. Social Problems: Overpopulation brings about social problems such as bribery, prostitution, armed robbery, etc.
4. A decrease in the standard of living: Overpopulation leads to a fall in the standard of living. As a result of the increased number of people, demand for essential commodities becomes highly competitive and it is those that are rich that would be able to afford them, thereby bringing a fall in the standard of living.
5. Water crisis: Egypt's population is mushrooming at an alarming rate and has increased by 41 percent since the early 1990s. Recent reports by the government suggest that around 4,700 newborns are added to the population every week, and future projections say that the population will grow from its current total of 92 million to 110 million by the year 2025. The rapid population increase multiplies the stress on Egypt's water supply due to more water requirements for domestic consumption and increased use of irrigation water to meet higher food demands. Egypt has reached a stage where the quantity of water is imposing limits on its economic development. The per capita share of water is

continuously declining. The present share is below 1000 cm/capita/year (Sep. 2004), a figure that, according to international standards, is equal to the “water poverty limit” for a nation. This value might drop to 500 cm/capita/year in the year 2025, which would indicate “water scarcity”.

- *Improve the scientific and technological environment for all.*

In the scientific world, execution is assessed, and correlations are made at basically four distinct levels: the individual specialist, the logical diary, the college or research association, and the nation. At each of these levels, execution pointers have been created that should assess quality, with a view to encouraging the undertakings of the overburdened evaluators. In Egypt, the scientific and innovative situations confront numerous weights and obstructions that irritate its way to reach and accomplish high worldwide positions. This test truly needs a brisk arrangement as it doesn't speak to just a fiasco however it is the establishment stone for any advancement venture in other sol.

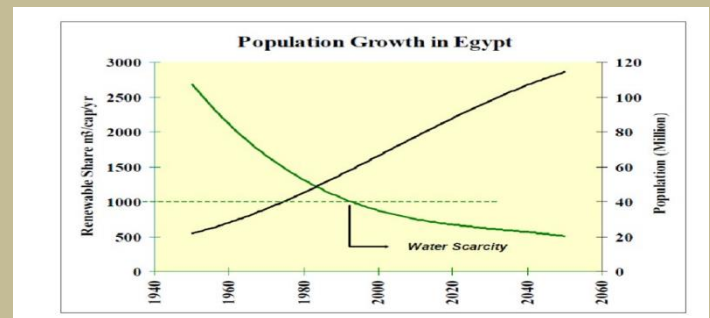


Fig (7)

## **Problem to be solved.**

The main and the most challenge that Egypt currently faces, that is mentioned in almost any literature that is related to energy in Egypt, is **the un-controllable and continuously increasing population growth**. Yet, the Egyptian energy sector has few other challenges that need to be dealt with seriously, otherwise Egypt will have to deal with a catastrophic energy situation within the few years to come. These challenges can be summarized in the following points:

- 1) The decline of Egyptian oil and natural gas reserves; as proved oil reserves have decreased from 4.5 million barrels in 2009 to 4.2 million barrels in 2013, while natural gas reserves have decreased from 78 trillion cubic feet in 2010 to 77.2 trillion cubic feet in 2014.
- 2) The fact that the current Egyptian energy mixture is not properly diversified, as Egypt, heavily and mainly depends on oil, natural gas and the hydroelectric power from the Nile, with the third being close to nothing and even descending more, then Egypt is left with only both oil and natural gas representing approximately 90.4-94.4% of the total primary energy consumption till 2014.
- 3) The gap between supply and demand of oil since the supply ratio is about 52.7% of the demand.
- 4) The majority of the Egyptian imported oil (~4.9 million tons), comes only from three suppliers: Kuwait, Iraq and Oman –according to the Egyptian Ministry of Petroleum- in 2014. Such a low variety of oil importers increases the probability of the risk of Egypt being negatively affected by any geopolitical instabilities in one or all of these importers, consequently affecting its ability to secure domestic demands in such situations.
- 5) The low percentage of private investment in the energy sector (~16% in 2014/15), which in a way confines and hinders the technological aspects of energy production, distribution and consumption.
- 6) The aging, unmaintained, low to no efficient. Egyptian infrastructure, especially in the energy sectors, which when faced with any sign of major problem, would lead to catastrophic outcomes, as for example, the daily blackouts of 2013 and 2014 summers, where electricity used to be completely absent all over Egypt for 6-8 hours/day through different times of the day.
- 7) The non-existence of clear, to the point and profound strategies to be properly integrated in the Egyptian energy sector, and the complete randomness of the existent mixed ones, which are mostly unreliable, un-



applicable strategies designed by totally different and varied institutions and energy-suppliers with different agendas and mentalities, eventually hindering any possible appropriate application or planning a proper solution(s) to secure energy supply.

The solution for these problems is summarized as in the following:

- 1- Increasing the variety of oil importers. (if importing is needed)
- 2- transition from non-renewable to renewable energy sources such as wind, solar, and hydroelectric power.
- 3- Egypt can harness the sun and wind power with which it is so abundantly blessed to help bring more of its citizens and companies the electricity they need in their daily lives. **The Gulf El Zeit**, for example, boasts some of the best wind resource in the world.
- 4- Scheduling the extraction of the non-renewable energy resource in a way that doesn't affect us

# **Research**

- What is the renewable (alternative) energies?
- The importance of renewable energies
- Types of renewable energies
- The problem of energy in world
- The problem global warming and climate changes
- What's mechanical energy.
- What are the advantages and disadvantages of mechanical energy?
- Common Recycled material and how to recycle it
- Natural materials and their properties
- The tools that will be needed, safety roles and how to use Fab Lab tools.
- The uses of electricity in our life and its important rule
- Tides, waves power and marine energy
- World cup ball "Elrehla"
- Pendulum and how does it works
- Generators and how do they work
- The perfect weight of a ball
- Rotation of a ball in different directions
- The watt equation

## **Other Solutions Already Tried**

### • **Mechanical energy (Hydropower)**

## **The Three Gorges Dam:**

It was called by "Three Gorges" to refer to the narrow gorges that the Yangtze River flows through in this mountainous region, it considers one of the most important dams around the world; Because, it is the largest hydropower project has ever build. It is since 2006

### **Its properties:**

- It has a surface water area of over 1080 square kilometers
- It is about 181 meters tall and 2335 meters' long
- It has the capacity to generate 22,000 megawatts of electricity



Fig (8)

### **From its disadvantages is**

- The dam depends on the coal in the first place which pollutes the environment by increasing the carbon dioxide which makes the air not clear
- Also it has shifted around so much water that it has slowed the Earth's rotation
- The sudden release of water from the Dam could result in massive flooding downstream, affecting millions of people who live in that area
- It also cost about 37 million dollars to build it so it is considered the highest cost dam ever  
(Miller, 2015)

## **The Hoover Dam:**

That great dam named by this name in the honor of the later president Herbert Hoover. The dam was dedicated in 1935 and the hydroelectric generators went online in 1937 It was built because of the residents of the Americans southwest sought to tame the Colorado to prevent flooding and providing irrigation to transform the arid region into fertile cropland, it located on the border between Nevada and Arizona

### **The advantages:**

- It controls the flooding of the Colorado river
- It irrigates to over 1,500,000 acres of land
- It provides water to over 16,000,000 people
- It maintains the water pressure levels up to 45,000 pounds per square inch

### The disadvantages:

- The Dam had a large impact on the Colorado River by affecting on fish habitats, sediment structures, water quality, and the capacity of the initial flood plains
- Over 100 construction workers were killed



Fig (9)

## Aswan's Dam:

Aswan's High Dam, is one of the world's largest embankment dams, which was built across the Nile in Aswan between 1960 and 1970, it was the tallest earthen dam in the world at this period, it is built to increasing the amount of hydroelectric power, maximizing the utilization of the river while controlling the flood, improving the storage of the water

The Aswan high Dam is 3,830 meters along, 980 meters wide at the base, 40 meters wide at the top and 111 meters tall

(Wikipedia contributors, 2023)

### **Advantages:**

- It serves the irrigation needs of both Egypt and Sudan
- It controls the flooding coming from the Nile's River and generates power and helps in improving navigation across the Nile
- The Dam improved water access for all Egyptians
- It reduces the issues of schistosomiasis because of the Dam

### **Disadvantages:**

- The project forced over 1 million people to be relocated
- Fertilization issues are now present in Egypt
- It encourages coastline erosion around the delta
- Local groundwater tables are influenced by salinity
- Sediment collections are lowering the reservoir's water storage capacity





Fig (10)

## • Mechanical energy ( Wind power)

### 1- Jiuqun wind power base farm in china

Effective methods for storing wind energy include batteries, compressed air energy storage (CAES), hydrogen production, pumped hydro storage, thermal energy storage, flywheels, supercapacitors, chemical storage, smart grids, demand response, and energy management systems.



Fig (11)

## 2- Gulf of Suez Wind Farm in Egypt

is a 504 MW onshore wind power project. It is planned for the Red Sea. According to Global Data, who tracks and profiles over 170,000 power plants worldwide, the project is currently at the under-construction stage.



**Fig (12)**

### *Mechanism fixing.*

We will fix the mechanism inside the ball as fixing the sensor in the ball of world cup in Qatar 2022 by using wires inside it to keep it at the center of the ball so we will do as it to fix our mechanism inside it without breaking it down in the mechanism and to make it more easier to make wire to take electricity from it after playing with the ball this wires will be made by rope not with plastic to prevent breaking down in these wires or in the mechanism to make it move free inside the ball



**Fig (13)**



**Fig (14)**

# Solution and Design Requirements

## *Solution requirements*

- **Efficiency:** We intend for building a dam that is extremely effective, but both inexpensive and labor-intensive. To create a dam with a lovely outward shape, we should use simple materials.
- **Effectiveness:** Our project must be above 85% to be effective. To make the project effective focusing primarily on the goal of the project and actions to be undertaken to achieve that goal.
- **Low cost:** The materials should be affordable and available.
- **Easiness to be applied:** The project should be simple and easy to apply so that anyone can apply it by reading the documentation of the project.
- But there should be specific requirements for every project and differ from one to another.

# **Design Requirements**

- **Design requirement:** Choose a proper design requirement(s) based on your idea, for example:
  - User friendly (how much easy that device to be used).
  - Environmentally friendly (either by not polluting the environment or by getting rid of environmental pollution).
  - Fast in producing energy (rate of producing energy through measuring the power produced).
  - Non-impediment (your device will not negatively affect the students' activities) You may find another design requirement (s) according to your idea. Constrain:
- **Constrain:**
  - Use ONLY fab lab tools to create your device, no external fabricated organizations are allowed!
  - You must follow ALL School Safety rules and documents in your Capstone Portfolio. Failure to do so will result in a reduced grade.
  - No equipment or materials that belong to the laboratories can be removed from the laboratories at any time. You must conduct those tests that require this equipment in the labs. Failure to do so will result in a reduced grade.
- Your device must meet the following:
  - Produce at least 150 Joule in at most 5 minutes.
  - Store the energy in any electric storage device to be able to be used any time.
  - Show the stored electric energy in a useful application (e.g., lightening, electroplating...etc.) that can assess the amount of the saved power.
  - Using waste material in your construction is allowed.
- **Materials:** All materials should be natural or waste materials. You are allowed to use some laboratory equipment to test your device.

# Selection of Solution

## Mechanical energy

Energy is everywhere. Introduce young readers to mechanical energy with this visually engaging text. Mechanical energy is defined through accessible language, explaining basic concepts such as potential and kinetic energy. Learn how mechanical energy has been harnessed in inventive ways over the course of history. Readers discover different sources of mechanical energy and how it can be transformed through real-world examples. The text also shares opportunities to observe and measure mechanical energy in the classroom and beyond, and it features questions that encourage the reader to investigate the topic further.

## Advantages of Mechanical Energy

1. **Versatility:** Mechanical energy can be used to power a wide variety of machines and devices, from simple levers and pulleys to complex machinery such as automobiles, airplanes, and power plants.
2. **Reliability:** Many mechanical energy sources, such as hydroelectric and wind power, are renewable and have a low environmental impact.
3. **Efficiency:** Many mechanical energy conversion devices, such as gears and turbines, are highly efficient at converting energy from one form to another.
4. **Low cost:** Mechanical energy sources, such as fossil fuels and nuclear power, are relatively inexpensive to produce and distribute.

## Disadvantages of Mechanical Energy

1. **Limited availability:** Some mechanical energy sources, such as fossil fuels, are non-renewable and will eventually run out.
2. **Environmental impact:** The extraction and use of some mechanical energy sources, such as fossil fuels and nuclear power, can have a negative impact on the environment.
3. **Maintenance:** Mechanical systems can be complex and require regular maintenance, which can be costly and time-consuming.
4. **Noise pollution:** Mechanical systems, such as wind turbines, can generate significant amounts of noise, which can be a nuisance for people living in the vicinity.



## Generators

A machine that converts mechanical energy into electricity to serve as a power source for other machines. Electrical generators found in power plants use water turbines, combustion engines, windmills, or other sources of mechanical energy to spin wire coils in strong magnetic fields, inducing an electric potential in the coils. A generator that provides alternating current power is called an **alternator**. See also induction.



Fig (15)

### Some countries used generators:

- Turkey
- China
- Germany
- Italy
- Japan
- Netherlands



# Selection Prototype

We are asked to generate electricity from renewable resources by using human activity, so we decided to use ball to generate electricity from rotation of the ball during playing.

**Our project is divided into two parts:**

## 1. The mechanism:

- motor (dynamo): to rotate inside the ball
  - Pendulum: for fixing part of the dynamo and transferring the rotation motion to the dynamo
  - Lithium battery + Holder: to store the energy produced
- The whole unit of the mechanism is fixed using the strategy of fixing the sensors in Qatar World Cup 2022 ball “Elrahla.”

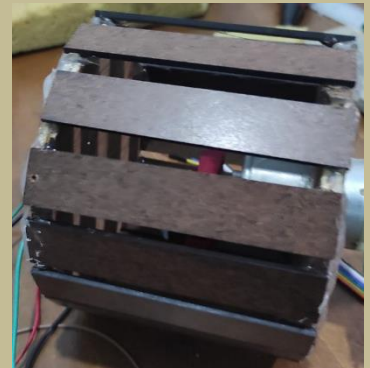


Fig (16)

## 2. The components of the ball itself:



We researched to determine materials that can withstand ball rotation without breaking down the mechanism, so we found that the most suitable material is **the sponge** as it is the best choice for filling the ball from inside, to absorb the pressure applied on the ball.

For the outer layer that cover the ball, **fabric** was chosen as it can deal with pressure applied on ball and the ball will be easily used



Fig (17)

## Materials and methods

| Item                | Image   | Function   | Cost  | Quantity | Source                   |
|---------------------|---|--|-------|----------|--------------------------|
| Dynamo              |    | Transferring Kinetic energy into electric energy | -     | <b>1</b> | Waste (toys)             |
| Lithium Battery     |   | Storing the energy produced                      | -     | <b>1</b> | Waste (rechargeable Car) |
| Electric Wires      |  | Connection of the electric circuit               | 10L.E | <b>1</b> | Recycled                 |
| 3d Printer filament |  | Making the box of the mechanism of               | -     | <b>1</b> | Fab lap tools            |




|                 |  |  |       |          |                                     |
|-----------------|--|--|-------|----------|-------------------------------------|
| Sponge          |   | Filling the shape of the ball  | 40L.E | <b>1</b> | Recycled (from recycled mattresses) |
| Ball            |   | Contain the materials of the project all together (key of the project) | -     | <b>1</b> | Waste                               |
| Electric bridge |  | To get use of the two directions of the rotation                       | 10L.E | <b>1</b> | Recycled (from broken circuit)      |

Table (1)

**Total cost: 60L.E**

## **-Methods:**

The methods which are followed are as follow:

- 1- Making the mechanism between the motor(generator) and the bridge to get use of the two directions of rotation.
- 2- Making the pendulum using plastic filaments to rotate the generator.
- 3- Fixing the pendulum on the generator.
- 4- Making the circuit of the mechanism and applying the lithium battery.
- 5- Making a box to contain all the parts of the mechanism.
- 6- Fixing the box on the frame of the ball.
- 7- Filling the ball with the sponge to shape it.



Fig (18)

## **The safety precautions we took in constructing prototype:**

- ❖ Wearing masks to avoid strong smells.
- ❖ Wearing gloves because it isn't good conductor of electricity and the reaction between the polyester and its hardener.
- ❖ Is an exothermic reaction.
- ❖ Working under supervision.
- ❖ never work alone.



Fig (19)



Fig (20)

## Test plan

Our test was divided into two parts, and each part must pass completely the design requirements for the project to be ready for work. so we predicted some results for each test.

### 1) **The mechanism:**

-We must generate 150 joule/5minutes

-**This will be achieved by:** putting a pendulum that will be used to move the motor in two different directions (positive-negative) and an electric bridge will be placed to exploit both movements while the ball is moving.

- **This will be tested by:** using the following tools:

a) voltammeter → to measure voltage

b) ammeter → to measure amperes



Fig (21)



Fig (21)

c) equation of work to → calculate how many joules per second

## 2)The design of the ball:

-We are asked to generate electricity from human activities, so we chose football as our model. A regular ball will be brought and filled with sponge from the inside to absorb shocks so that no damage occurs to the device.

**-This will be achieved by:** using sponge to fill the ball and plastic for the frame of the ball, because of what we studied in Lo9 Chemistry, that the sponge has high bouncing and malleability, which maintain the balance of the ball

**- This will be tested by:** applying pressure on the ball to test the resistance of the materials to the pressure.

## Data collection

### Measuring Tools

| Item       | Image   | Function   | Cost | Quantity | Source                     |
|------------|---|--|------|----------|----------------------------|
| Multimeter |  | It is used to measure volt and ampere to calculate watt. | -    | <b>1</b> | From physics lab in school |
| Stop watch |  | To calculate the time                                    | -    | <b>1</b> | From physics lab in school |




|         |  |                                   |   |          |                              |
|---------|--|-----------------------------------|---|----------|------------------------------|
| Balance |  | To measure the weight of the ball | - | <b>1</b> | From chemistry lab in school |
|---------|--|-----------------------------------|---|----------|------------------------------|

Table (2)

After testing the prototype according to the test plan, these data were collected:

### Negative results:

1- After forming the circuit using the motor, pendulum and so on the rotation of the ball was only useful in one direction.as the generator could only generate positive electricity in the positive direction and in the other direction it didn't generate electricity.

**Solution:** This problem was solved by using the electric bridge which is used to unify the positive charges in one direction and the negative charges in other direction

2- After finishing the design of the pendulum, we had founded an error of about (-100) gram the mass we needed

**Solution:** This problem was solved by changing its mass by putting a piece of metal to make it heavier.

### Positive results:

The generator could produce from two directions and an amount of  $(3.7 \pm 0.7)$  volt and  $(0.180 \pm 0.03)$  ampere was generated which is approximately equals  $(0.66 \pm 0.2369)$  watt

So, the design requirements were fulfilled, and more than 150 joules were produced.

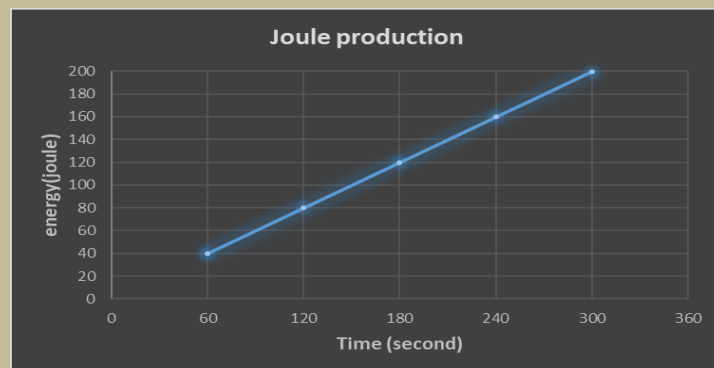
**This graph shows the energy production  
per minute approximately during testing  
the revolving of the box:**

| voltage | ampere | watt  | time | joule  |
|---------|--------|-------|------|--------|
| 3.7     | 0.18   | 0.666 | 60   | 39.96  |
| 3.7     | 0.18   | 0.666 | 120  | 79.92  |
| 3.7     | 0.18   | 0.666 | 180  | 119.88 |
| 3.7     | 0.18   | 0.666 | 240  | 159.84 |
| 3.7     | 0.18   | 0.666 | 300  | 199.8  |

Table (3)

**-As shown below the results were:**

**Production of approximately 199.8 J**



Graph (1)

# Analysis and Discussion

The laws that we were used during building and testing the prototype:

- It is ordered to produce 150 joules in 5 minutes:

$\text{Watt} = \text{joules} / \text{time}(\text{second})$ .

So, the energy production should be 0.5 watt

- The equation of volts, ampere, and watt:

$\text{Power} = \text{electric potential} * \text{electric current}$

$\text{Watt} = \text{volt} * \text{ampere}$ .

So, the product of **voltage** and **ampere** should be equal to 0.5 **watt**.

- The prototype should withstand the pressure applied on the ball.

$\text{Pressure} = \text{force} / \text{area}$

## **Trial 1 (failed)**

The first trial for the prototype didn't come with positive results:

- The pendulum weight was lighter than what was needed. Which caused a decrease in the rate of its revolving and a decrease in the voltage rate. (As shown in graph 2)

This problem was solved by: increasing the weight of the pendulum as it is needed to be



Fig (23)



Fig (24)

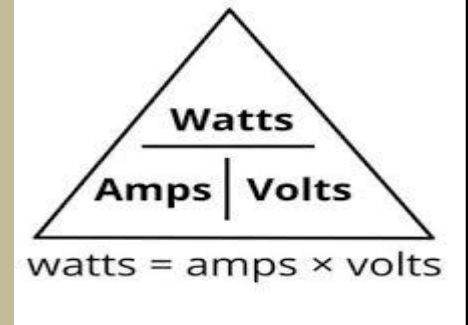
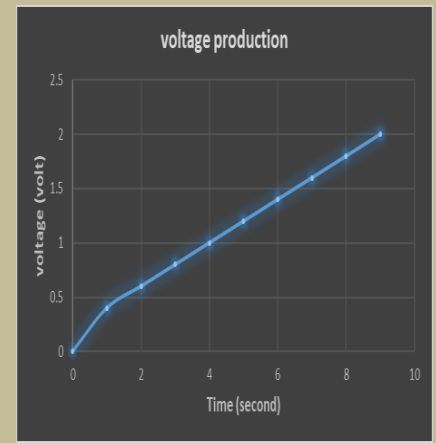


Fig (22)

This graph shows a weak voltage power due to the problem with the pendulum's Weight:

| voltage | time |
|---------|------|
| 0.1     | 1    |
| 0.2     | 2    |
| 0.3     | 3    |
| 0.4     | 4    |
| 0.5     | 5    |
| 0.6     | 6    |
| 0.7     | 7    |
| 0.8     | 8    |
| 0.9     | 9    |
| 1       | 10   |

Table (4)



Graph (2)

### Trial 2 (partially failed)

- The pendulum weight was fixed correctly; the problem was that the energy produced in two different directions wasn't useful. Only one direction of rotation was used by the generator.

This problem was solved by using an **electric bridge** to unify the two directions of rotation.

### Trial 3 (Succeeded)

- This trial came up with promising results:

The voltage data was (As shown in figure 25)



Fig (25)

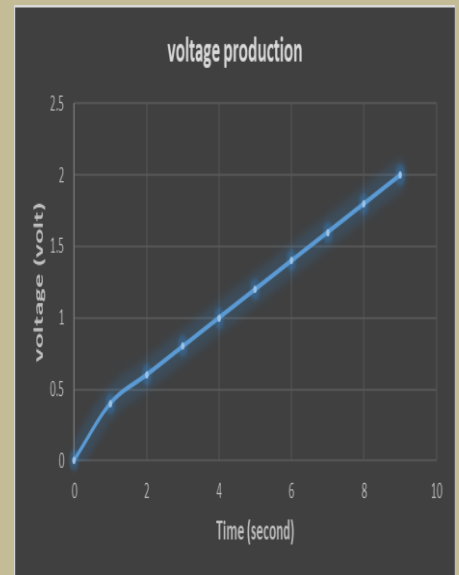


Fig (26)

**This graph shows the voltage power after fixing the pendulum's weight**

| voltage | time |
|---------|------|
| 0       | 0    |
| 0.2     | 1    |
| 0.4     | 2    |
| 0.6     | 3    |
| 0.8     | 4    |
| 1       | 5    |
| 1.2     | 6    |
| 1.4     | 7    |
| 1.6     | 8    |
| 1.8     | 9    |
| 2       | 10   |

Table (5)



graph (3)

## Recommendations

- Fill the ball with ethylene-vinyl acetate because it is too soft, light and has high bounce.
- Making an airless ball by 3D printer using material called polymer lattice which has high bounce, and it is so light.
- Replacing the pendulum with a spinner that when you spin it with a small force it rotates fast that produces a lot of electricity.
- Increasing efficiency by using the help of factories to make your prototype more professional and has a smaller number of errors that can found.
- Making sure that the weight of the ball is not affected by the mechanism box.
- Choosing better materials for the ball frame to increase the bouncing.
- In the large scale, the frame of the ball should be formed on the mechanism of the generator (not vice versa).
- Decreasing the size of the box to be easily fixed inside the ball.
- Changing the motor generator to generate more electricity in less time.

## Learning Outcomes

| <u>S</u> ubject                 | <u>C</u> onnection  |
|---------------------------------|---|
| <u>C</u> hemistry<br>(lo9)      | through chemistry we learned bounce, texture, strength, and elasticity which helped to choose the appropriate material needed.  |
| <u>C</u> hemistry<br>(lo13)     | knowing the metals and nonmetals and its characteristics, choosing the appropriate materials for our projects   |
| <u>M</u> ath<br>(lo7)           | Using sin function and graphs to form the AC current graph that represents the amount of energy released from generator.  |
| <u>E</u> arth science<br>(Lo 9) | Learning more about the Renewable resources such as: solar, wind, and biomass power.<br><br>Other sources of energy can also be used for electricity. These sources include water, geothermal energy, solar thermal energy, photovoltaic energy, and biomass. |
| <u>E</u> arth science<br>(Lo 8) | Learning more about the Earth's energy resources, such as solar, geothermal, and magnetic energy, by using earth science.   |
| <u>P</u> hysics<br>(lo9)        | Using it to measure the pressure of ball as we learned in.  |
| <u>E</u> nglish                 | Helped in writing our portfolio and poster  |
| <u>M</u> echanics<br>(lo 6)     | Measuring the difference forces applied on the ball   |
| <u>M</u> echanics<br>(lo 9)     | Measuring the centripetal force and velocity  |



Table (5)

## **List of Sources in APA Format**

### **Books:**

- Greene, R. (2015). *The 48 laws of power by Robert Greene: The mindset warrior summary guide*. The Mindset Warrior. Law 7 page:17
- Horne, R., & Horne, R. (20). *3D printing*. John Wiley & Sons, Inc
- Purcell, E. M. (2011). *Electricity and magnetism*. Cambridge University Press. Ch.1.1 page(1to48)
- Seward, C. (2011). *Ball lightning explanation: Leading to Clean Energy*. Seward Publishing.

### **Research paper:**

- Harvesting Energy from Soccer Balls. (2018, February 2).  
<http://large.stanford.edu/courses/2010/ph240/hernandez2/>

- (PDF) paper-based batteries: A Review. (2019, March 2). [https://www.researchgate.net/publication/259318076\\_Paper-based\\_batteries\\_A\\_review](https://www.researchgate.net/publication/259318076_Paper-based_batteries_A_review)

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- *Doe explains...Batteries*. Energy.gov. (n.d.). <https://www.energy.gov/science/doe-explainsbatteries>
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- *U.S. Energy Information Administration - EIA - independent statistics and analysis*. How electricity is generated - U.S. Energy Information Administration (EIA). (n.d.). <https://www.eia.gov/energyexplained/electricity/how-electricity-is-generated.php>