

# An introduction to Renewable Energy Systems (12210588)

## Lecture 1

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### **Renewable vs nonrenewable energy pros and cons**

- Energy is an important aspect of every living organism. Organisms need to obtain energy from food to carry out their daily work.
- According to law of thermodynamics, energy cannot be created or destroyed but can be transformed from one form to another.
- This is law of energy conservation. For example, battery transforms its stored chemical energy to electrical energy for it to do the intended work.
- There are different forms of energy which include:
  - mechanical energy such as kinetic energy
  - radiant energy that originate from sun and
  - thermal energy obtained from heat. Electromagnetic energy from radio waves and microwaves together with
  - chemical energy
  - others

### **Sources of energy**

Depending with energy regeneration, energy can be categorized into two main different sources which are:

1. renewable and
2. non renewable sources

#### **1. Renewable sources of energy**

- They are obtained from different natural sources.
- The main common sources are sunlight, wind, tides and geothermal.
- They comprise approximate 16% of total global energy that is consumed on daily basis.
- They can be replaced and used continuously without becoming depleted.
- They are used in three different areas which include:
  - electricity generation
  - heating by use of solar hot water and
  - motor fuels (bio-fuel)

### **Pros of renewable sources of energy**

1. Renewable and easily regenerated
2. Clean energy (does not pollute the environment)
3. Available everywhere (e.g., solar energy)
4. Maintenance cost is relatively cheap.

### **Cons of renewable sources of energy**

1. Produce less energy quantity than that of nonrenewable fuels
2. Technology required to trap renewable energy is costly (e.g., dams)
3. Most sources are affected by weather thus reducing their reliability. (e.g., hydro generators need constant rainfall that will overflow the dams, wind turbines only rotate if there is wind of a given speed)

### **Nonrenewable sources of energy**

- Produce constant energy because of their high availability.
- Sources of nonrenewable energy can be attributed to natural sources that are not regenerated once the source is depleted.
- Sources include fossils fuels such as coal and petroleum products e.g. natural gas and diesels

### **Pros of nonrenewable sources of energy**

1. Easy to transport from one area to another
2. Cost of producing nonrenewable energy is low since they are naturally available
3. Cheap to transform from one form of energy to another
4. Not affected by climatic condition

### **Cons of nonrenewable sources of energy**

1. Produce harmful green house gases which contribute global warming
2. Coal once burnt produces carbon dioxide harmful to the environment

3. Cannot be replaced making them expensive to obtain

Source: <http://renewablegreen.net/?p=124>

## **Renewable Energy in Palestine2**

### **Solar energy:**

- The average solar insolation in Palestine is **5.4** kWh/m<sup>2</sup>/day, indicating a high potential.
- The West Bank, in the Jordan Valley, receives high radiation levels of 5.40-5.98 kWh per day annually. Total annual sunshine is approximately **3,000** h. These are excellent conditions for harnessing solar energy for both large-scale and stand-alone applications. The potential of solar sources is estimated to account for **13%** of electricity demand.
- Domestic solar water heating (SWH) is widely used in Palestine. It is estimated that at least **70%** of houses have such systems. SWH has proved to be feasible compared with other alternatives. For example, the energy cost from solar heater is about \$0.17/kWh and is much cheaper than the electricity price from the grid (\$0.11/kWh).
- **Summary:** Palestine has a high potential to utilize solar energy.

### **Wind energy:**

- Two companies, Israel Wind Power based in Ramat Gan, near Tel Aviv and Brothers Engineering Group from Bethlehem in the West Bank, have announced their intention to cooperate in the building and selling of wind turbines in the West Bank region and beyond.
- Average wind speeds in the country vary from **3-4** m/s in coastal regions, to **6-10** m/s in more elevated areas of the country, indicating a moderate potential for wind power.
- Using a 100-m wind turbine with blade length of 52 m and power coefficient of 0.4, the annual power that can be generated is 3.3 and 3.8 GWh for the northern and southern West Bank, respectively.
- Using a wind farm of **50** turbines, each would generate 355 GWh/year, which could account for **6.6%** of the electricity need in the Palestinian Territories.

- The high density of buildings and the scarcity of open and empty lands in the [Gaza Strip](#) obviate the possibility of building wind farms there. However, [offshore wind farms](#) could be installed in the Mediterranean Sea, were it not for present political obstacles.
- Today, the only large-scale wind turbine in the Palestinian Territories is at the [Al-Ahli Hospital](#) in Hebron. This turbine provides 40% of the hospital's energy needs.
- [Summary](#): The low speed winds in the Palestinian Territories may encourage using wind energy in stand-alone systems to provide small electricity loads.

### **Geothermal energy:**

Middle East and North Africa Geothermal (MENA, [www.menageothermal.com](http://www.menageothermal.com)) announced in June 2010 the opening of the country's first geothermal power plant in Ramallah, with a 23 kW cooling load and a 21 kW heating load.

### **Biomass energy:**

- Palestine is an agricultural country, with many different types of plant products that can be used as energy sources. The main source is a rejected residue of olive oil pressers called [Jefit](#).
- Usually, Jefit is used in households for heating in the winter.
- Annual production of Jefit had been not assessed yet, but there are plans to do so in cooperation between the Ministry of Agriculture and the Palestinian Central Bureau of Statistics.
- From agricultural residues, 22,800 tons of [diesels](#) can be generated, which could account for nearly [5%](#) of the national diesel consumption.

### **Biogas energy:**

- Assuming [50%](#) collection, the availability of fresh manure of medium-size cattle in the Palestinian Territories amounts to approximately 165,000 kg per day.
- If [20](#) kg of wet mass of manure produces [1](#) m<sup>3</sup> of gas at 25 °C, then the total biogas production for the Palestinian Territories' amount of cattle would be 8250 m<sup>3</sup> per day.
- Similarly, assuming 50% collection, the availability of fresh manure of goats and sheep amounts to 50,000 kg per day.

- 6 kg of wet mass produces 0.5 m<sup>3</sup> gas per day at 25 °C, and produces a total of 4166 m<sup>3</sup> of gas per day. Combined with the cattle's biogas production, the Palestinian Territories could produce 12,416 m<sup>3</sup> of biogas per day or approximately 4.5 million m<sup>3</sup> per year.
- **Summary:** The produced biogas could account for 10-20% of cooking energy needs for the rural population.

### Hydropower:

- Hydro-electric potential in the country is **limited**, with no major resource survey as yet conducted.

Source: <http://www.reegle.info/profiles/PS>

### **Conclusion** (Source: <http://www.ecomena.org/renewables-palestine/> )

Palestine can reduce reliance on imported energy carriers by deployment of clean energy systems, especially solar, geothermal and biomass.

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## **THE PALESTINIAN SOLAR INITIATIVE**

قامت سلطة الطاقة الفلسطينية بإعداد إستراتيجية للطاقة المتجددة كجزء هام من منظومة المصادر، حيث تحتاج فلسطين الى طاقة كهربائية أكثر وأنظف، وتهدف سلطة الطاقة الفلسطينية الى الحصول تدريجيا على 240 جيجا واط ساعة لتوليد الكهرباء من مصادر الطاقة المتجددة بما يعادل 10% من القدرة الكهربائية المنتجة محليا بحلول عام 2020 وذلك حسب الخطة الإستراتيجية لقطاع الطاقة.

وتشمل الخطة على عدة مراحل، تبدأ بالمرحلة الأولى مبادرة تم الاتفاق على تسميتها المبادرة الفلسطينية للطاقة الشمسية Palestinian Solar Initiative (PSI). تتكون هذه المبادرة من ثلاثة مراحل تمتد لمدة ثلاث سنوات من منتصف عام 2012 حتى منتصف عام 2015. تهدف هذه المبادرة الى إقامة مشاريع صغيرة متفرقة بقدرة 5 كيلو واط لكل مشروع يتم تركيبها على أسطح المنازل للحصول في العام الأول على نصف ميغا واط من 100 منزل وتوسيع المشروع ليصل إلى توليد واحد ونصف ميغا واط خلال العام الذي يليه وفي العام الأخير من المشروع يتم توليد 3 ميغا واط اضافية اي بمجموع 5 ميغا واط خلال الثلاث سنوات، اي ما يقارب 1000 منزل موزعة بنسبة 30%، 40%، 30% في شمال، وسط، وجنوب الضفة الغربية على التوالي بالاضافة الى 400 منزل في قطاع غزة عندما يمكن ذلك.

وكخطوة تحفيزية من قبل الحكومة، فإن كل مواطن يقوم بتركيب هذا النظام في منزله سيحصل على تعرفه كهرباء مميزة

للطاقة المنتجة، ويكون مجلس تنظيم قطاع الكهرباء هو المنظم خلال تنفيذ هذه المبادرة.

Source: <http://www.sunergy.ps/data/uploads/6674d802b697e0c1c9297ecd7c3889f1.pdf>