Alternative Sources of Energy

Filip Cima

Vysoká Škola Báňská - Technická Univerzita Ostrava

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1 Introduction

There are five general ways to obtain electricity besides nuclear, thermal power stations and from other, non-renewable sources.
These are:

1. Solar energy
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4. Wind energy
5. Solar energy

In following sections we will focus on describing each type of energy and later in the document we will pay attention to explaining how a wind turbine works and how a community can be self sufficient in energy industry.

2 Major types

2.1 Solar Energy

Solar power is the conversion of sunlight into electricity using photovoltaic effect (explanation) It is the most common alternative source of energy you can install at home. It is also used for warming water up, making electricity, drying clothes, heating up homes. People think that it's the best thing going from an enviromental perspective.

Figure 1: Solar panels at MIT university.

2.1.1 Photovoltaic

Photovoltaic solar technology directly converts sunlight into electricity using panels made of semiconductor cells. These are the panels we can find on roofs of houses more and more often.

2.1.2 Solar

This type captures the sun's heat. This heat is used directly or converted into mechanical energy and in turn electricity, known as concentrated solar power . This heat is used directly (low-temperature solar thermal) or converted into mechanical energy and in turn electricity (concentrated solar power – CSP).

2.2 Hydropower

Hydroelectric power generates about 10 % of US energy. Flowing water creates energy that can be captured and turned into electricity.
The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir. Water released from the reservoir flow through a turbine, spinning it, which in turn activates a generator to produce electricity.
There are more types of hydroelectric power plants - for example pumped storage plant, which can even store power.

Advantages:

- Dams are designed to last many decades.
- Lake's water can be used for more purposes.
- Water can be stored if there's not much energy needed.

2.3 Geothermal energy

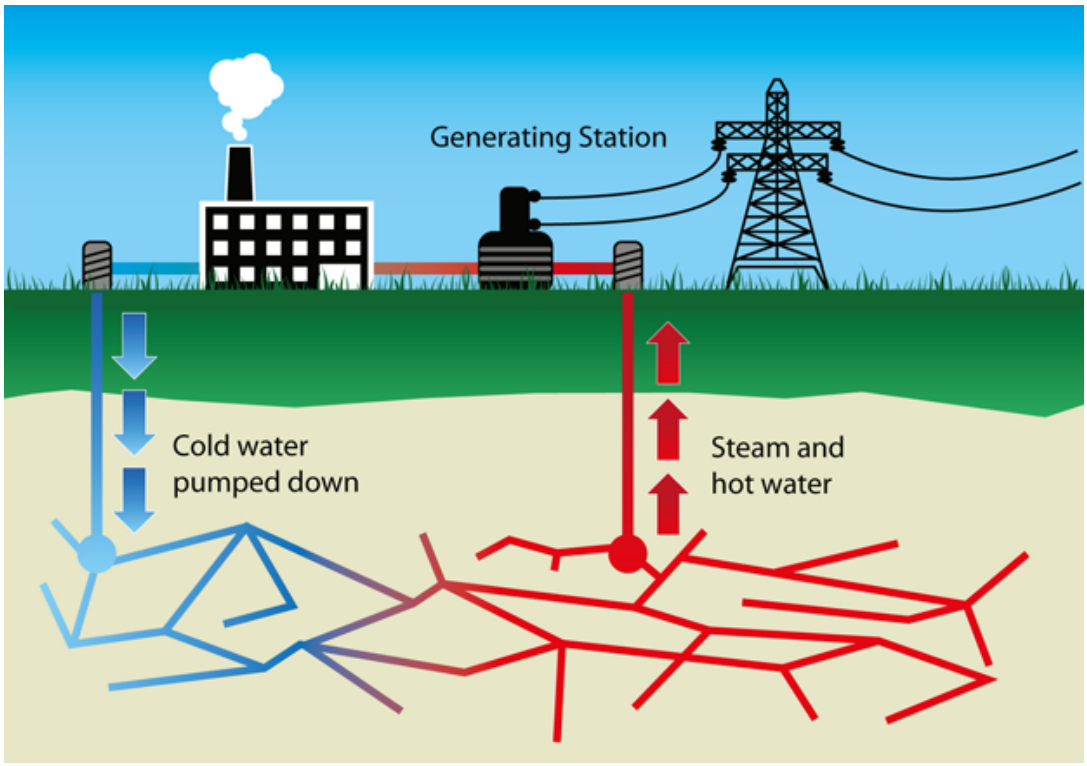

Figure 2: Geothermal plant.

Geothermal energy is heat energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. The geothermal energy of the Earth's crust originates from the original formation of the planet and from radioactive decay of materials *(in currently uncertain but possibly roughly equal proportions)*. The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a **continuous conduction of thermal energy** in the form of heat from the core to the surface.

We distinguish **three basic types of geothermal energy**:

- **Liquid-dominated plants**
  - more common with temperatures above 200 °C
  - found near young volcanoes surrounding Pacific Ocean
  - generates around 2-10 MWe
- **Thermal energy**
  - water can be piped from geysers directly into radiators
  - Iceland is the world leader in direct applications of thermal energy
- **Enhanced geothermal systems**
  - EGS actively inject water into wells to be heated and pumped back out.
  - zero environmental damage
  - small scale EGS can be seen in France, Germany

2.4 Wind energy

Wind power is the use of air flow through wind turbines to mechanically power generators for electric power. Wind power, as an alternative to burning fossil fuels, is **plentiful**, **renewable**, **widely distributed**, **clean**, produces **no** greenhouse gas **emissions** during operation, **consumes no water**, and uses little land. The net **effects on the environment are far less problematic than those of nonrenewable power sources**.

2.4.1 Wind farms

A **wind farm** is a group of wind turbines in the same location used for production of electric power. A large wind farm may consist of **several hundred individual wind turbines** distributed over an extended area, but the land between the turbines may be used for agricultural or other purposes. For example, Gansu Wind Farm, the largest wind farm in the world, **has several thousand turbines**. A wind farm may also be located offshore.

Large onshore wind farms:

Wind Farm	Country	Current capacity
Gansu Wind Farm	China	6,800 MW
Muppandal Wind Farm	India	1,500 MW
Alta	United States	1,320 MW
Jaisalmer Wind Park	India	1,064 MW

2.5 Self sufficient country in energy

In our english text book we have a picture showing a little electricity-independent town. Look at the picture below and think about its implementation in real life. Is this even possible?

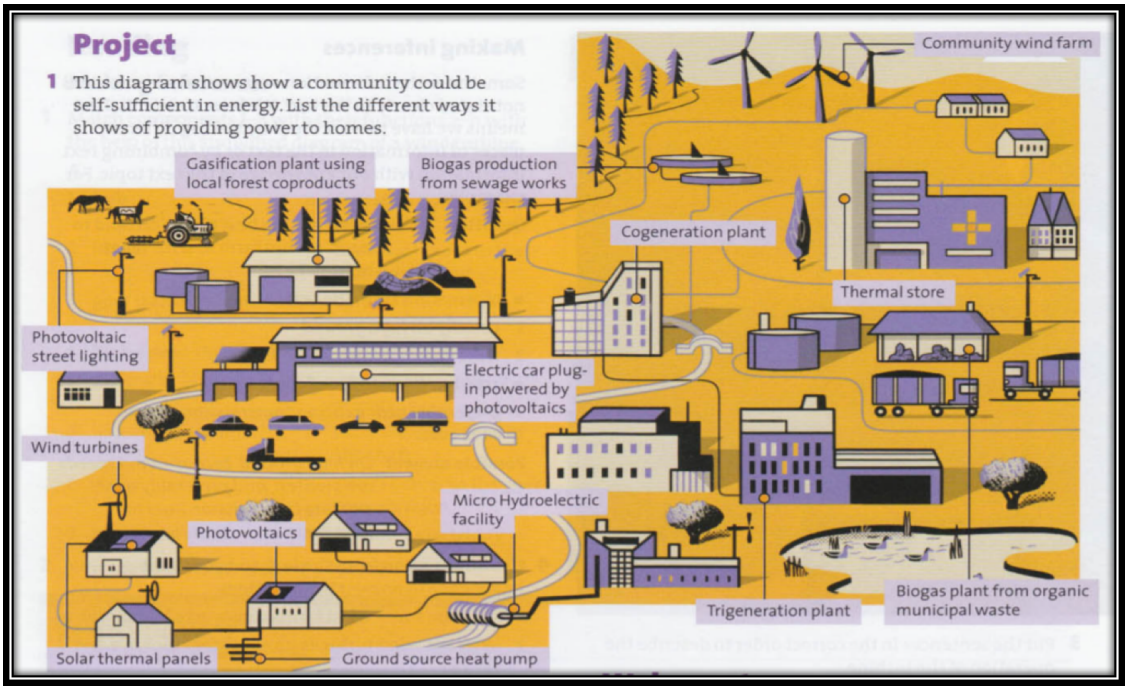

Figure 3: Textbook example of a self sufficient community.

3 Something more to add

3.1 Can we have code snippets in LaTeX?

Hell yeah!

```
// Hello LaTeX!
public static void main() {
   System.out.println("Hello from TEX!");

   for(int i = 0; i < 3; i++)
      System.out.println("Supercool!");
}
```

3.2 How about math formulas?

No problem, boss.

3.2.1 Arrays

Arrays of mathematics are typeset using one of the matrix environments as in

$$\begin{bmatrix} 1 & x & 0 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} 1 \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} 1+xy \\ y-1 \end{bmatrix}.$$

Many arrays have lots of dots all over the place as in

$$\begin{matrix} -2 & 1 & 0 & 0 & \cdots & 0 \\ 1 & -2 & 1 & 0 & \cdots & 0 \\ 0 & 1 & -2 & 1 & \cdots & 0 \\ 0 & 0 & 1 & -2 & \ddots & \vdots \\ \vdots & \vdots & \vdots & \ddots & \ddots & 1 \\ 0 & 0 & 0 & \cdots & 1 & -2 \end{matrix}$$