

In order to suggest innovative solutions for Barcelona's renewable energy systems and their distribution network, all resources should be examined individually.

In terms of renewable energy, Barcelona has 4 resources, which can be followed as: Eolic Energy, Hydroelectric Energy, Solar Energy and Biomass Energy.

**Eolic Energy:** Barcelona (Mainly Cataluña) region is having so much wind, but the wind energy is having the percentage of 10% at renewable energy division. There are 3 wind farms serving Barcelona, and 2 more that are not in use. At this case the solutions can be; increasing the number of wind farms, designing wind farms closer to city centre and encouraging people -who are able- to build their own wind farms. The minimum distance between Barcelona's active wind farms and Barcelona city centre is 65 km. Also this distance creates "the distribution" loss for energy. Noise is a problem for wind farms but nowadays with new systems, the noise that is created can be decreased. Also, designing and building big wind farms can be problem and can have high cost. It is also common that people can be self sufficient in their land/farm and use wind power by building 1-2 wind turbine.

**Hydroelectric Energy:** Barcelona has a rich landscape with water resources. But only 2 dams are serving Barcelona, for clean water network and energy network. Like wind farms, they are quite far from Barcelona too. Llobregat and Besos Rivers can be used for building dams, even Tordera River can be an opportunity. Regarding the fact that 65% of energy is provided by hydroelectric energy, making new investments will be inevitable.

**Solar Energy:** Barcelona's most efficient energy resource is Sun, because the city is having 2800 hours of sunshine per year. It is appreciated that Cataluña Government is encouraging people to use solar energy at dwellings but still solar thermal and solar hot water systems can be used more in Barcelona. *Solar thermal* applications make up the most widely used category of solar energy technology. These technologies use heat from the sun for water and space heating, ventilation, industrial process heat, cooking, water distillation and disinfection, and many other applications. Solar thermal collectors are characterized as low, medium, or high temperature collectors. Low temperature collectors are flat plates generally used to heat swimming pools. Medium-temperature collectors are also usually flat plates but are used for creating hot water for residential and commercial use. High temperature collectors concentrate sunlight using mirrors or lenses and are generally used for electric power production. *Solar hot water* refers to water heated by solar energy. Solar heating systems are generally composed of solar thermal collectors, a fluid system to move the heat from the collector to its point of usage, and a reservoir or tank for heat storage and subsequent use. The systems may be used to heat water for home or business use, for swimming pools, or as an energy input for space heating and cooling

and industrial applications. A solar heating system can provide a very high percentage (50% to 75%) of domestic hot water energy. In that case, solar energy should be more widespread in Barcelona; it has more advantages than all others.

Biomass Energy: In terms of Biomass, it is obvious that people aren't educated and they don't know so much about the power that they have. Regarding the fact that 55% of household waste can be used to produce energy using Biomass, people should use that power. Governments and municipalities should encourage investors about Biomass factories.