Environment and territory

The advantages of hydroelectric energy

Just like other types of renewable sources, hydroelectric energy is characterised by remarkable advantages as compared to the production of electric energy from fossil fuels. To begin with, it is a renewable and endless source. Secondly, emissions of polluting substances into the air and water are virtually absent, since no combustion process is involved. In particular, carbon dioxide (CO2) emissions are reduced by 670 grams for each kW/h of energy output. Other advantages are: a low dependence on ester energy sources, source diversification and the regional re-organization of energy production.

Moreover, mini-electric plants, in many cases, thanks to their hydraulic arrangement, create many advantages to the watercourse (in particular to the regulation of floods in water streams, especially on the mountains characterized by soil deterioration), and can efficiently contribute to the protection and safeguarding of the territory.

In some cases, the artificial lake that forms as a consequence of a weir or dam can improve the surrounding area, by allowing the development of tourist, sports and productive activities that can coexist together with hydroelectric exploitation. The chance to accumulate water and then regulate its flow downhill can also contribute to reduce floods and encourage a better use of water resources, which are becoming more and more precious and rare.

Really clean energy?

Hydroelectric power suggests, in our mind, the idea of a clean source of energy, that is eco-compatible and especially a source of energy that is renewable. Actually, a large power plant has problems in connection with the environmental impact, problems of an aesthetical nature, electromagnetic pollution and overload of the ground.

Water intake decreases the amount of water in the streams and rivers downstream from the power plant and provokes disorders in the river ecosystems with severe damage for the fish- and naturalistic heritage. According to the law, water intake must not exceed a percentage of the natural flow, and what is called the “minimum vital flow” must be guaranteed, in order to protect life and the ecosystems of the river or stream. Actually during the periods of draught, long stretches of the waterways become quite dry, with consequent damages to the environment. The negative effects are not only limited to parts of the river downstream of the power plants, but may be noted in the entire water supply network, a decrease in the flow rate of the waterways consequently leads to a greater concentration of the pollutants in the water and also in the underground water table that they supply water to.

With regard to the future development of hydroelectric power, in Italy, as in most of Europe, this type of resource has been almost completely exploited, i.e. the hydroelectric power plants have been built in almost all the locations where there were ideal conditions to exploit the kinetic energy of water precipitating towards the valleys from the mountains. It is therefore difficult to increase the number and the power of the existing park of hydroelectric power plants. In other large regions of the world, this form of energy is available in large amounts, and still has not been exploited.

It is the case of Africa, where as a result of the low consumption of energy per person and the low level of wellbeing, this type of energy can become precious and important to support the economic development of these populations. A second limit of the hydroelectric power plants are the vast areas of territory that are often occupied and flooded by very large dams, which are built for the purpose of accumulating the water that is necessary to move the turbines constantly. It is therefore necessary to modify the original plan of the territory and the natural flow rate of the rivers and streams, which, in some cases, causes environmental impacts on the ecosystems and economic impacts on other agricultural or industrial activities.

Therefore large hydroelectric plants with a reservoir require opportune assessments with regard to the impact on the environment, in order to guarantee the absence of interference with the natural environment. Underground Hydroelectric Power plants partly eliminate the aesthetical problem, however there is the problem of the disposal of the excavation materials, and these plants can influence underground water circulation.
Visual impact
With reference to the visual impact of large hydroelectric plants, they are difficult to hide and quite eye-catching. This is why it is necessary to carry out a careful assessment of the plant on the territory, by also making an aesthetical assessment. Any element in a plant (bars, intakes, power plant, restoration works, electrical substation) can determine a change in the site visual impact. In order to reduce the impact, some elements can be disguised with the vegetation; it is possible to use colours that better integrate with the landscape and build a part of the installations underground (i.e. the power plant).
Acoustic pollution provoked by a power plant is usually generated by turbines and turn multiplication mechanisms. At present the noise can be reduced up to 70 decibels inside the power plant, to imperceptibles levels from the outside. For example in Fiskbey 1 power plant in Norrkoping, Sweden, there is a maximum internal noise of 80 decibels and 40 decibels outside, at 100 m distance. This is a totally acceptable value. Noise is therefore easy to sort out.

Relation with the ecosystems
The relation with the ecosystems is fundamental when designing a hydroelectric power plant. Two aspects are strictly linked to the collection of superficial water and can provoke two different impacts:

- Impact related to the variation (reduction) of the water quantity, with possible consequences for the users, that could argue about the use of water and impact on aquatic fauna;
- Impact related to the change in the water quality as a consequence of quantity variation (i.e. higher concentration of pollutants) and as a consequence of vegetation change on river banks.

If a dam for a basin power plant is built, the consequences will be the following ones: above the barrier a reservoir will form and therefore there will be running water (lotthic water) moving in still water (lenthic water), with a longer time needed to exchange water and a possible impact on the ecosystem. Underneath the barrier, until the area where the water used by the plant is released, the watercourse may be dry for some periods of time unless a continuous release is guaranteed so that the river has a suitable minimum flow rate. The minimum flow rate (to be guaranteed according to the law), that ensures the natural development of all biological and physical processes, is called “minimum vital outflow”. All these aspects have to be taken into consideration during the impact assessment. This is why some choices are made during the design phase and precise precautions are taken to avoid any type of damage to the ecosystem. The reduction in water flow rate does not have to be excessive, and it is necessary to respect the minimum vital outflow value, since otherwise it is possible to damage the deposit, incubation, growth and transit of fish. With regard to the latter aspect, it is necessary to take into consideration the movement of fish that go up the current and the fish that go down the current, by building the adequate passages, installing the most suitable nets to prevent the fish from entering into the intake areas and get into the turbine (some types of turbines can kill the fish). When a dam is built to supply a hydroelectric plant, it is necessary to think about the different ways water can be used: drinking water, agricultural water or industrial water. The size and management of the dam must be compatible with all these needs, by optimising the use of water as a resource, since in some regions water is not sufficient to satisfy all these needs.

Dams and the local climate
The presence of a dam influences the microclimate of the territories all around due to the large mass of water that collects upstream of the dam. In fact water has a high thermal capacity, a parameter that indicates the quantity of heat required to raise the temperature of a body 1°C, which means that water absorbs a great amount of heat, which it takes from the atmosphere, in order to warm up. In summer therefore the water absorbs great quantities of heat from the air thus mitigating the atmospheric temperature. The opposite takes place in winter, when the water cools, releasing a large amount of heat in the atmosphere. Near artificial reservoirs, in summer the atmospheric temperature is lower than in the surrounding areas, because the water takes away the heat from the air. In winter the microclimate in the lake area will be
warmer than in the surrounding area, because the lake gives off the heat it has stored to the atmosphere which becomes warmer. The extension of the area concerned depends on the volume of water that the dam can hold back.