## recharge.green – balancing Alpine energy and nature

The Alps have great potential for the use of renewable energy. Thereby they can make a valuable contribution to mitigating climate change. This, however, means increasing pressures on nature. What could be the impact of such changes on the habitats of animals and plants? How do they affect land use and soil quality? How much renewable energy can reasonably be used? The project recharge.green brings together 16 partners to develop strategies and tools for decision-making on such issues. The analysis and comparison of the costs and benefits of renewable energy, ecosystem services, and potential trade-offs is a key component in this process. The project will last from October 2012 to June 2015 and is co-financed by the European Regional Development Fund in the Alpine Space Programme.

www.recharge-green.eu

## Choose MFD as a percentage of the mean annual discharge(%):

**Current**

Current means that the MFD is the legal one. There is a different legislation in each region. The calculation for Piedmont and Veneto regions are explained below.

**25 %**

The MFD is 25% of the natural discharge. It means that the discharge which can be exploited is 75% of the natural discharge.

**50 %**

The MFD is 50% of the natural discharge. It means that the discharge which can be exploited is 50% of the natural discharge.

## Note:

We compute the minimum flow discharge following regional plans and legislation without considering additional legal constrains, i.e. Water Frame Directive or Protected areas constrains. These restrictions to the potential are mandatory to preserve and valorize the ecosystem services but due to the complexity of each case study, only simplified options can be visualize in this tool. To introduce more variables and parameters, we refer to the open source software *r.green.hydro* that is available ad GRASS add-on.

**Piedmont:**

Due to the high impacts of hydropower on water quality and ecosystem, the Italian law n. 183 in 1989 provided the first indication to define the environmental flow. In the Piedmont Region legal framework, the Minimum Flow Discharge (MFD) was defined in1995 with the approval of

D.G.R. 74-45166, afterwards revoked. For its evaluation, the national law with the D.M. 28/07/2004 establishes the methodology for MFD evaluation and also the chance to estimate it with “regional” methods.

We refer to the local plan “Piano di tutela delle acque” introduced in 2007 as transposition of the Water Framework Directive (Directive 2000/60 EU) prescriptions. The plan defines three Minimum Flow Discharge parameters due to the specifics contest and scope of their application: hydrologic, basic and environmental MFD.

We evaluate the basic $MFD_{basic}$ starting from the hydrologic MFD by adding morphologic and hydrogeological parameters (regional normative n. 8/R-17/07/2007):

$$MFD_{basic} = K\ q_m\ S\ \ M\ A\left[{}^{l}/_{s}\right]$$

where $q_m$ is the specific average contribution of the natural flow [l/s km2]; $K$ is the experimental parameter associated with homogeneous areas; $S$ is area of the catchment [km2]; $M$ is morphologic parameter; $A$ is the parameter of interaction between surface and ground water. All parameters $K,\ M,\ A$ are reported in the regional rule n. 8/R-17/07/2007.

To compute the $q_m$ we use the suggested regionalization method:

$$q_m = 0.00860\ H + 0.03416\ A - 24.5694$$

with H altitude of the catchment [m] equal to $(0.9\ H_{max} + H_{min})$, $H_{max}$ and $H_{min}$ respectively are the maximum and minimum altitude of the corresponding catchment and $A$ is the average annual precipitation evaluated with isohyet map [mm].

The environmental $MFD_{env}$ in protected areas is defined as:

$$MFD_{env}\ =\ MFD_{basic}\ N\ Q\ F\ T$$

with $N,\ Q,\ F,\ T$ corrective parameters referring to naturalness, water quality parameter, water fruition and downstream flow regulation.

Due to the lack of the parameters definition, in this case study, the current MFD is the $MFD_{basic}$ basic.

**Regione Veneto:**

In the Veneto region, the Annex 1 to the Italian “Delibera n. 4/2004 del Comitato Istituzionale in data 3 marzo 2004” allows to calculate the current MFD thanks to this formula :

$$Q_{MFD} = ( K_b + K_n ) * 177 * S^{0.85} * Q_{spec} * 10^{-6}$$

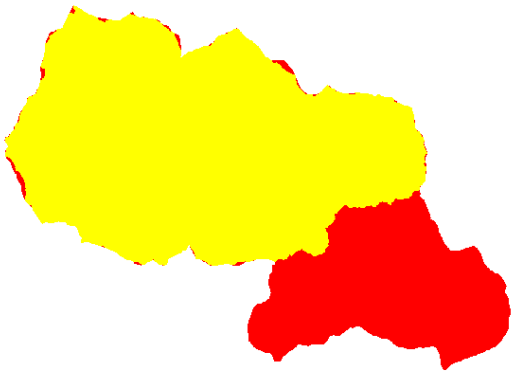
where $K_b$ is the biological criticality index,
$K_n$ is the naturalistic criticality index,
S is the catchment area, in km2,
$Q_{spec}$ is the specific flow-rate per unit area of the catchment, in l/(s.km2)

$K_b$ is typically within the range of 1-1.6; higher values are chosen for a river whose aquatic ecosystem is considered to be of a particular environmental value.

$K_n$ is typically within the range of 0-0.6; higher values of such index are used for basins having a particular naturalistic value, for instance national parks.

The values of $K_b$ and $K_n$ are imposed by the Piave River Catchment Authority (PRCA). There are different values depending on homogeneous segments which can be found in a table made by the PRCA. Also the values of $Q_{spec}$ depend on the area and are available in such table.

Here is the map of the Mis valley with colored areas to define the $K_n$, $K_b$ and $Q_{spec}$ values.



The legal values for the Mis valley are :
$K_n$ = 0.4 in the whole region (yellow and red zones)
$K_b$ = 1.4 in the yellow zone and 1.6 in the red zone
$Q_{spec}$ = 44 l/(s.km$^2$) in the yellow zone and 43 l/(s.km$^2$) elsewhere (red and white zones)