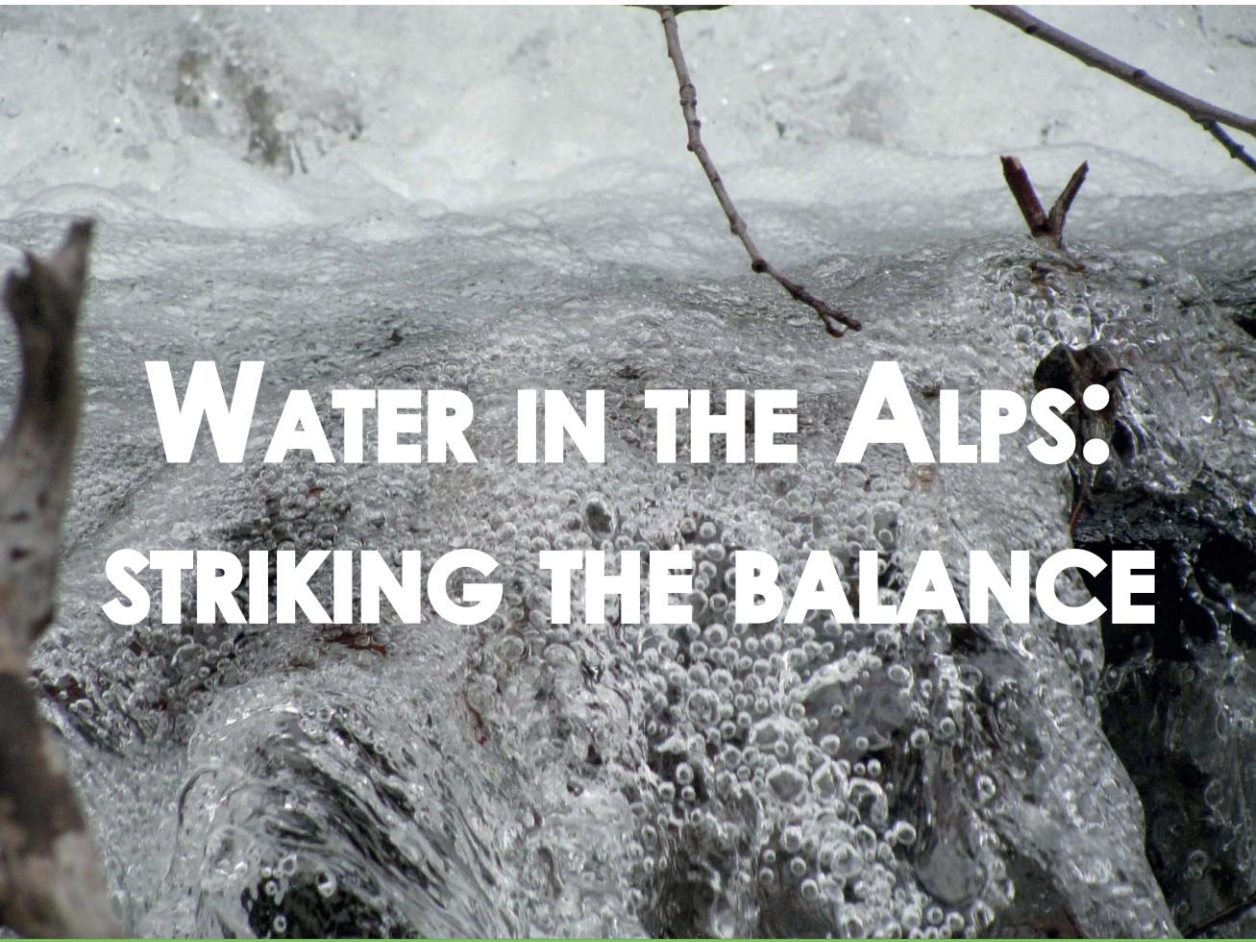

WATER IN THE ALPS: STRIKING THE BALANCE

3RD INTERNATIONAL CONFERENCE AND PREPARATORY WORKSHOPS 2010

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MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

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"WATER IN THE ALPS"

AND PREPARATORY WORKSHOPS

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"WATER IN THE ALPS"

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PREFACE

The Alps are widely known as the “water tower” of Europe because of their influence on the continental water balance.

Due to their position at the centre of Europe, they supply a disproportionate amount of water to a wide area, going far beyond the slopes of the Alps: the non-mountainous parts of the catchments of the larger European rivers profit from the Alpine runoff for a large share of water, varying from the 26% of Danube to the 53% of the Po river.

Water runoff from the Alps benefits an impressive territory, going far beyond the peri-alpine belt, hosting more than 60 million inhabitants and covering more than 350,000 square kilometers, supporting life, the environment, agriculture, industry and – in a word – a full regional economy.

Since the beginning of twentieth century, the Alps have been a major source of renewable energy, which now contributes to the commitment made by the EU of reducing CO_2 emissions and improve the share of renewable energy production. More than 550 hydropower plants with a generation capacity higher than 10 MW are located in the Alps, being able to deliver more than 2900 GWh each year and of helping to stabilize the European energy grid sustainably. These facts drive the approach to water management in all the region, as the legal initiatives at the EU level and their ongoing application in the Alpine countries, discussed in the present publication, show.

Unfortunately, such abundance of water carries also some remarkable risks. According to OECD (2007), natural disasters between 1980 and 2005 provoked more than 330 casualties in the Alps. Several of them are directly or indirectly related to the presence of water and its management: floods, but also avalanches, mass movements, and landslides. Floods, that become particularly dangerous in winter for lowland and densely populated areas, though representing less than 20% of the extreme events reported in the region, generated losses for some 37 billion Euros in the 1980 – 2005 time-span, that is more than 65% of the total economic damage, according to MunichRe (2006). Alpine countries took note of this and started to cooperate aiming at reducing the incidence of these hazards and their social and economic consequences.

The number of issues related to water management in the Alps are countless. The 3rd International Conference on Water Balance in the Alps and the precise collection of the insights provided by the participants in it and its preparatory workshops helps organizing this impressive information, that is now ready to be returned to a hopefully large audience of stakeholders.

Corrado Clini

General Director, DG SEC -Department for Sustainable Development, Energy and Climate – Ministry for the Environment, Land and Sea, Italy

INTRODUCTION

This volume aims at being a collection, hopefully of some benefit, of a large group of issues that are possibly affecting a public administration involved in the infinite subject of water management in mountainous regions.

The collection will allow us to discuss three principal main points on the water balance in the Alps: planning at the river basin level and the related management of natural hazards linked to water; the interpretation of water resource as a part of an ecosystem that has to be protected and enhanced; the economic value of water and its hydroelectric use.

The framework of this publication mirrors the history of the 3rd Alpine Water Conference, which was built upon three thematic workshops, of technical nature, each corresponding to one of the above mentioned mindsets, and a plenary session, more comprehensive and political in nature.

It is worth recalling that the editing structure does not relieve the reader of the responsibility to go in search for the often strict and intricate connections that can be identified among the three sections: from the impacts on the environment and the landscape of protective measures, to the economic and social risks linked to the installation of a hydropower plant, to the capability of healthy ecosystems to improve the resiliency of a territory or to reduce the drinking water purification costs.

Neither the mountainous nature of the analyzed areas can be underestimated. It makes complicated an already tough topic, by asking the interpreter to consider the whole scope of the policies for which he is responsible – which in turn is commensurate with the geographical dislocation of resources (water in particular) and ecosystems and at the same time with the actual scope of the services which they deliver.

Though far from being exhaustive, we try to supply the benevolent and willing to follow reader with a *vademecum* or guide to orient herself within the text and among the principal issues it addresses.

In the first section, water is mainly seen as a risk factor with regard to the safety of alpine settlements, infrastructures and residents. Land use change, major development of urban centres, economic growth and increase in the

value of investments on the territory, improved mobility of people, goods and services made these areas more sensitive to natural hazards than they used to be. Historically spatial planning and land use management have responded to this increased vulnerability through the coordination of the territorial development, early warning systems, prevention facilities and large monitoring networks. Today very often integrated solutions and soft measures are implemented, grounded on economic incentives and cultural actions, based on public participation of the citizens. This approach can become especially profitable when hazards are not foreseeable, their return periods long are high and similarly difficult to foresee, and the impact are “out of scale” (they are “black swans”, actually). Climate change has been considered responsible for variations in both frequency and intensity of natural hazards: this had led to new approaches for the territorial defense, the protection from natural hazards, or the reduction of their risk. The availability of advanced tools to evaluate the hazards and the monitoring of the territory does not always allow to capture all the “shadow-factors” being jointly responsible for the impacts or their changes in frequency or intensity.

In the Alps, the regions and the other public administrations in charge of river basin management (e.g. Basin Authorities in Italy) have often initiated (with variable degree of success) the zoning of the areas affected by hydrogeological risk through ad hoc mapping. Sometimes they applied homogenous methodologies for each physiographic unit, sometimes they devolve the mapping to the local level (municipalities) and keep to the region the definition of guidelines. Often though hazard maps have not been translated in appropriate urban planning tools: an action that would have been largely hoped.

In the second section the focus is placed on the protection of mountain ecosystems. In particular water ecosystems and all the other which are relevant for the conservation of water quality or the regulation of extreme events are considered, as it is the case with forests. Notwithstanding the generally “good status” of water in the Alpine basins, a significant part of them will find difficult to meet the objectives set by the Water Framework Directive 2000/60/EC for 2015. Similarly complex would be the task to implement the river basin management plan, also through the transfer of implementation costs to the users, through fees and fares. At the same time it is necessary to set up a well

built monitoring system, compliant with the requirements of the Directive aimed to orient and weights the action to be put in place to achieve the quality objectives. Widening the array of collected figures (e.g. consumption of underground water) and adopting univocal indicators in the classifications and the calculation methodologies aiming at making possible to build up comparisons over time and between different situations only can assure the effectiveness of monitoring. Critical elements that are often ignored by the classification methods used in the Plans are the hydromorphological impacts due to the hydropower exploitation and to the hydraulical defense facilities. River and lake contracts, tested for instance in France, are promising public participation tools to set up a negotiated programming, harmonisation of different plans insisting on the same area, and thus for the implementation of management plans. These contracts are flexible tools and do not produce further constrains. Forest ecosystems can participate in reducing natural hazards induced by climate change (avalanches, floods, water shortages, etc.) by performing protection functions, assuring (securing) slopes and the whole alpine territory (safety). Nevertheless climate change has negative impacts on forests' growth and health, tree species distribution and development, total economic value of a forest, with consequences on the local economy. There is though still a high degree of uncertainty on how the several functions of the forests are influenced by climate change. Recognizing the value of mountain ecosystems of the Alps, also as biodiversity hotspots, could make profitable including in the list of European areas of special interest, that are recipient of specific resources and conservation programmes.

In the third section hydropower generation is dealt with. This robust industry is to be found in the Alps since a long period of time and participated in regional economic growth, enhanced the use of renewable sources, but has also impacted on the environment and landscape. Two main directives have been considered: 2000/60/EC (water framework directive) and 2009/28/EC (climate and energy from renewable sources). A need has emerged to look for a harmonization between incentive payments to production and environmental impact, especially of small hydropower plants (on which the Water Platform of the Alpine Convention issued ad hoc Guidelines). The uncontrolled growth of public subsidies to power from renewable sources in Europe has made profitable initiatives economically not sustainable and produced an

unprecedented increase in the demand of new licenses, especially for small plants. Water scarcity, coupled with features of the industry and territorial and environmental aspects, makes unsustainable a full exploitation (which neither is favourable in the long run), for many reasons (e.g. conflict in use, ecological and landscape impacts, well established large plants and water storage facilities, desirability of an investment diversification strategy on the territory). From both an economic and ecological point of view suitable criteria and methodologies should be identified to earmark a part of the economic rent from hydropower production aiming at improving the quality of life of residents and the alpine environment. Still to be assessed is the worthiness of legislative initiative processes, in progress in some regions, aimed to directly involve public territorial authorities in the management of the plants. In fact, it is generally agreed that licenses can participate in a balance sharing of the rent (e.g. if they are commensurate with the effects of the operations on the water body, or they allow to start compensation mechanisms and incentives to ecosystem functionality), but the concomitant role of manager and regulator of the public authority in a regulated sector, where there are discretionary powers in the award of the licenses. It is to be hoped that the controlling and the controlled subjects are distinct entities with distinct roles. A reform of incentives to power production from renewable sources should aim at setting the subsidies proportionately to the positive externality deriving from the production of green power and to the negative one from the environmental impact. At the same time it is worth valuing the microeconomic initiatives of voluntary certification and the growing commitment to implement Corporate Social Responsibility (CSR) in the utilities sector. At the macro level, a preliminary strategic planning (pre-planning), at the appropriate territorial level (e.g. basin or sub-basin) would allow identifying the most suitable locations for plants on the basis of environmental, social and economic criteria. This would also prevent a total freeze on new licenses. The local level would then dictate the specific criteria for building up new plants in the identified sites. At-large there is a need to adopt measures for upgrading and improving the efficiency of existing facilities in order to minimize the need for new plants aimed at producing further hydropower.

To sum up and broadly, these are the topics dealt with in the volume. Of the unnumbered implementation experiences, theoretical approaches and issues

raised from the administrations involved in water management in the Alps, the ones collected here represent a modest fraction. Though, the useful scientific and institutional discussions carried out since the beginning of this collection and the proposals of further inputs received confirm the growing interest for the matter and the perspective of its profitable evolution. To this purpose we hope this volume could contribute.

1 HYDROGEOLOGICAL RISK IN THE ALPINE ENVIRONMENT*

* Text reviewed, based on the presentations exposed at the 1st session of the 3rd International Conference "Water in the Alps", Venice, Italy, 25th-26th November 2010, and at the Preparatory Workshop n.1 "Hydrogeological risk in the alpine environments", Trento, Italy, 29th September 2010.

1.1 Natural hazards[1] in the alpine environment

The Alpine region is a particularly rich territory from the natural and cultural points of view, and in which settlements, economic activities, recreational facilities and infrastructures coexist.

But the geomorphological characteristics make it to some extent an unstable area and subject to action of different natural processes (floods, avalanches, debris flows, landslides and rock falls) which could heavily interfere with human activities and represent a danger for people and goods.

In particular, water and processes linked to water-cycle, besides being fundamental resources for these territories, represent the major factor of danger because river basins of mountain areas are complex systems, highly dynamic and therefore difficult to manage.

Hydrogeological risk in the Alps is linked to different natural events which assume peculiar characteristics on the basis of orography and geology of sites (table 1.1). For example the flat areas are more likely to be affected by floods and mudflows, whereas in mountain areas in case of floods (mainly flash floods regarding small basins of 1 to 10 km^2) prevails a phenomenon in which the debris are carried on by water (Rigon, 2010) [2]. In this context the debris flows represent probably the major problem, since generally they are composed by a very dense front of rubbles and water and which can reach speeds over 60 km/h with a great destructive power (see specific box at the end of the paragraph).

[1] Hazard: is a condition, situation or process from which damage may arise for humans, the environment and/or material goods. Source: PLANALP - Platform on Natural Hazards of the Alpine Convention (2010). *Integral natural hazard risk management: recommendations.*

[2] Rigon, R. (2010). *Hydrogeological hazard in the alpine areas: science, research, perspectives*. Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.

Table 1.1 - Types of hazard according to sites topography (Greminger, P. J. 2010)[3]

Lowlands	floods				
Hills	flash floods	some landslides		rock falls	
Alpine area	flash floods	landslides	debris flows	rock falls	avalanches

In the Alpine area the level of risk is particularly dependent from the stability of slopes and, thus, to land use and to the condition of the forests providing a protective function. Constructive protection measures are not always sufficient to guarantee a certain safety because in certain occasions there are no free spaces or no available funds for their construction, or because the risk situation is a result of a complex and dynamic interaction between land use, resources management, energy production and a selective risk perception that could be managed only by means of a holistic approach (Zischg, 2010)[4].

In the last few decades there has been an increase in the numbers of natural events number in the Alpine area which caused deaths and economic damages for millions euro (Greminger, 2010). This state of things has favoured, on one hand, the materialization of a series of actions aimed at the decrease of hydrogeological risk (more attention to land use planning, forest resources improvement, slopes stabilization works, events monitoring, hazards and risks identification and forecast, prevention works achievement and maintenance, emergency situation management through early-warning-systems and Civil Protection procedures and interventions); on the other hand it has increased the awareness that it is not possible to have the full control over the power of nature, but rather it is conceivable to achieve a shared and acceptable security level (figure 1.1).

[3] Greminger, P. J. (2010). *Natural hazards in the alpine environment*. Third Alpine Water Conference, Venice, Italy, 25th -26th November 2010.

[4] Zischg, A. P. (2010). *Natural risks in the alpine environments and the PLANALP platform activities*. Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.

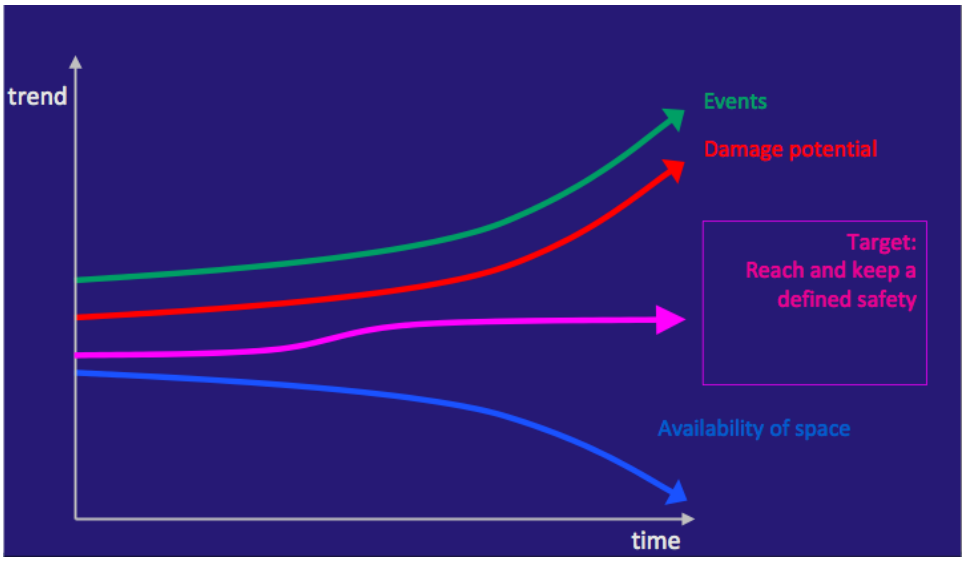

Figure 1.1 - Trends in occurrence of extreme events, damage potential, availability of space in the Alps (Greminger, P. J. 2010)

Furthermore, climate change may have a significant role on increased risk in Alpine areas, also if its effective contribution is difficult to quantify. Alpine area, in fact, for its intrinsic attributes is unstable and, therefore, also small variations, through a series of interactions, could bring to relevant effects on the territory (PLANALP, 2010)[5].

The Intergovernmental Panel on Climate Change (IPCC, 2007)[6] and the Environment European Agency's (EEA, 2009)[7] studies point out how between the 19th and 21st century, there has been a rising in the Alps of mean temperatures of about +2°C, that is approximately twice than mean heating

[5] Risk: (in a wider sense) is the possibility that a condition, situation or process may cause some damages; (in a narrower sense) is the magnitude (intensity) of a potential damage and the probability of its occurrence. PLANALP - Platform on Natural Hazards of the Alpine Convention (2010). *Integral natural hazard risk management: recommendations* (available from http://www.alpconv.org/theconvention/conv06_WG_c_it.htm)

[6] IPCC – Intergovernmental Panel on Climate Change (2007). *Climate Change 2007: Synthesis Report of the Fourth Assessment Report.* Cambridge, UK, Cambridge University Press.

[7] EEA - Environment European Agency (2009). Regional *climate change and adaptation - The Alps facing the challenge of changing water resources.* Copenhagen, EEA (Technical report No 8/2009).

registered Northern Hemisphere[8]. This trend has generated evident consequences on glaciers dimensions and on thermal zero altitude but it is not yet clear which role should have on distribution and intensity of local weather phenomena which have a heavy influence on high mountain basins.

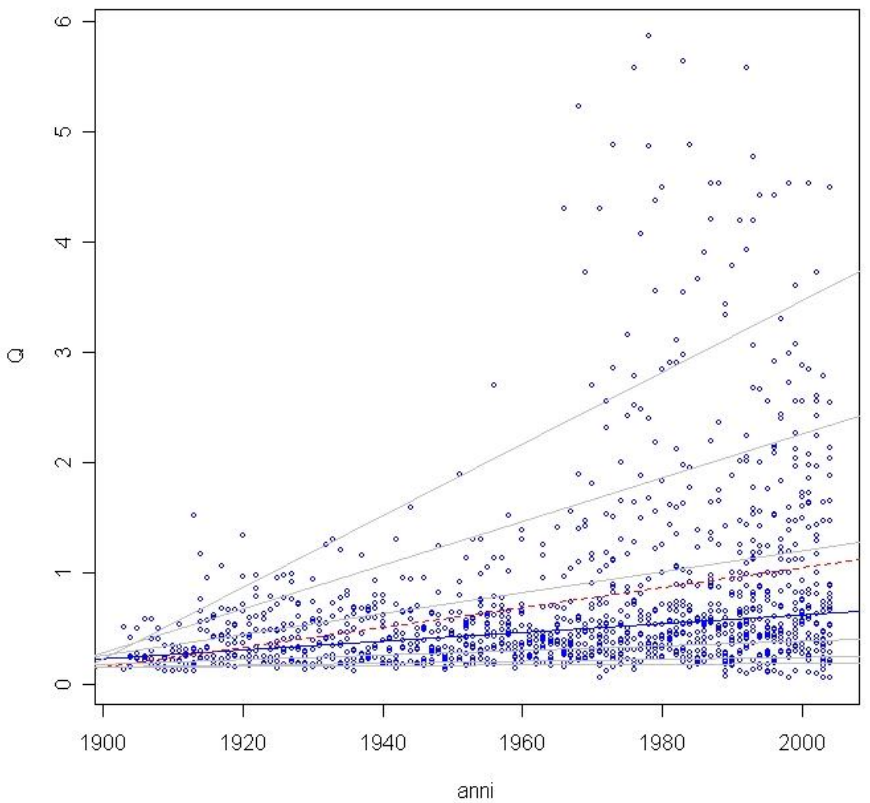

Figure 1.2 - Intensification of flood peaks in Swiss mountain basins (Claps, P. 2010 & Allamano, P. et al. 2009a)

[8] Taking into account that the relations between North Atlantic Oscillation (NAO – an index based on air pressure that represents a cyclical influence on Alpine mean temperatures and precipitations) and Alpine climate still present some scientific uncertainties and that also in mountain areas not influenced by NAO, such as Himalaya, there have been registered temperature increases amplified by altitude, it can be assumed that temperature increase in the Alps due to climate change is almost similar, to that observed on a global level. Source: Casty C. et al. (2005). *Temperature and precipitation variability in the European Alps since 1500.* International Journal of Climatology (Vol. 25, p.1855-1880).

Anyway, some studies point out that flood peaks in mountain basins are intensifying, likely due also to substantial differences in dynamics of snow accumulation (figure 1.3), which are one of the main variables in a geomorpho-climatic model (Claps, P. 2010) [9].

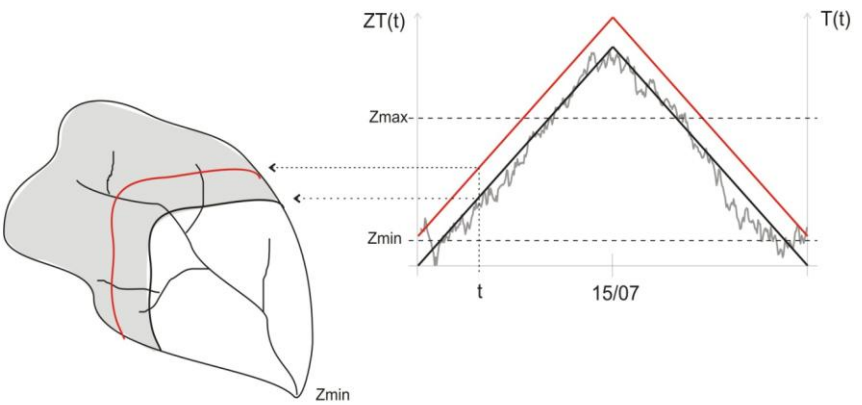

Figure 1.3 – Geomorpho-climatic model for an Alpine mountain basin: ZT(t) = thermal zero, A = river basin area, Ac(t) = contributory area, h = rainfall/snowfall, q = specific runoff, Fc(t) = Ac/A, SM = melting altitude (Claps, P. 2010 & Allamano, P. et al. 2009b)

Regional climate models predict a constant tendency of rising temperatures for the Alps until the end of the 21st century (between +2.6°C and +3.9°C), with an accelerated increase in the second half of the century. Changes in precipitations are expected to be moderate in terms of the yearly total, but will likely show significant changes within the seasons: mainly a decrease in summer precipitations and, in most regions, an increase in spring and winter precipitations (figure 1.4). Precipitations in winter will be increasingly more likely to occur as rain rather than snow, leading to fewer days of snow cover and greater runoff and floods in wintertime (EEA, 2009)[10].

[9] Claps, P. (2010). *European Directives and flood evaluation methods in alpine environments.* Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.
[10] EEA, (2009).

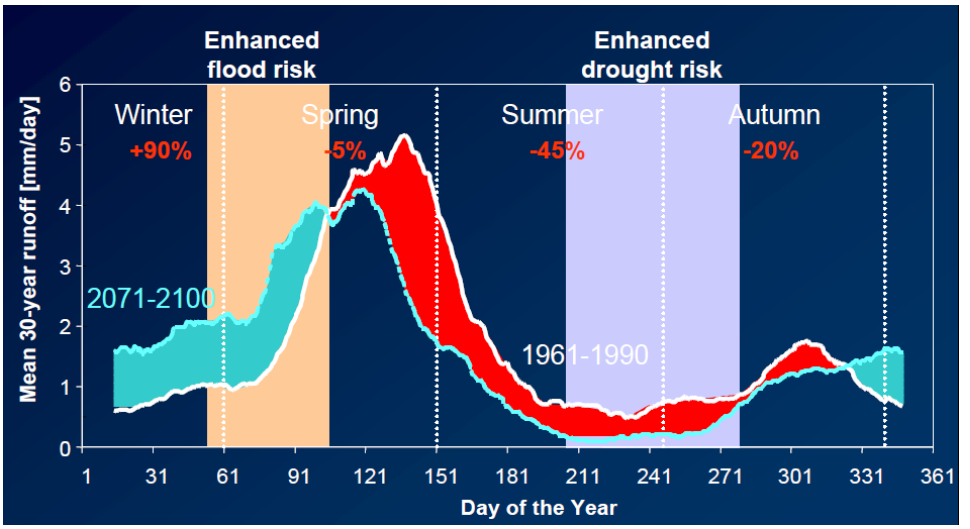

Figure 1.4 - Changes in runoff in the Alps according to HIRHAM RMC = A2 Scenario (Isoard, S. 2010 & IPCC 2011)[11]

Furthermore, an impact in return times[12] of the hazards is expected, such as new uncertainties due to heavy rainfall events (a stronger and more frequent occurrence of extreme weather events is likely to exacerbate the impacts of natural hazards), in parallel with an increase in the intensity of extreme events (figure 1.2) and different thaw parameters (in particular in the higher river basins) (Greminger, 2010; Claps, 2010)[13].

Anyway, if precise future trends can't be introduced in the planning instruments without doubts and uncertainties and different scenarios should be considered aiming at trying to understand the future impacts of climate change (Zischg, 2010). Furthermore, the effects of climate change to natural

[11] Isoard, S. (2010). *Climate change in the Alps and the impacts on water resources*. Third Alpine Water Conference, Venice, Italy, 25th-26th November 2010.

[12] Return time: how often, on average, a certain event is equaled or superseded in a same place. Naturally, the return time is also related to the considered duration of the event. Wider is the duration of a strong or extreme event, smaller is the probability of this occurs, i. e. the return time is higher. On small basins extreme events with the duration of 5-10 hours could have catastrophic effects, while the basin can adequately answer in the case of 2-3 hours events. (Rigon, P. 2010).

[13] Greminger, P. J. (2010); Claps, P. (2010), based on: Frei & Schär, (2001); Schmidli & Frei, (2005); Schmidli et al., (2007); Allamano P., Claps P., Laio F. (2009). *Global warming increases flood risk in mountainous areas*. Geophisical Research Letters, Vol. 36, L24404, ISSN: 0094-8276, DOI: 10.1029/2009GL041395.

hazards are varying spatially and differ from region to region. This high spatial variability of the different effects of climate changes have to be considered, a generalization over wide areas have to be avoided.

In this framework, to consider greater runoff of reference (+15/20%) could be a solution in order to manage flood protection (Eichenseer, 2010)[14].

This description of the framework entails political actions which takes into account adaptation measures to climate change and the Alpine Convention, in this sense, has instituted the Platform "Natural Hazards- PLANALP"[15], whose main objective is to provide the necessary decision-making information for the continued development of the adaptation strategies, as a basis for adjustments to hazard prevention in the Alpine region.

The change in land use is another factor capable to heavily influence the systemic vulnerability of Alpine areas (figure 1.5). The economic activities development, which in the last decades has interested these areas, leaded to a large settlements expansion (houses, hotels, industries, etc.) and to infrastructures (roads, ski resorts, etc.) with a consequent use of territory shares previously assigned to other purposes. This expansion has brought at the use of areas characterized by a greater hazard and the increase in settlement density and goods concentration, making current events of the same or similar intensity of the past more damaging than in the past. Therefore, vulnerability[16] is higher since anthropic systems' sensitivity - particularly in certain areas- is greater than in the past (Zischg, 2010).

Furthermore, lifestyles and, consequently, the needs of protection have changed: in fact, nowadays, the protection of the infrastructures has perceived increasingly important (Dellagiacoma, 2010)[17].

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[14] On this issue participated to the discussion held in Venice Mr. F.Puma, Secretary General of the Po River Basin Authority, supporting this point of view.

[15] Platform established by the VIII Alpine Conference, held in Garmisch-Partenkirchen in 2004.

[16] Vulnerability is defined as the condition of a given area with respect to hazard, exposure, preparedness, prevention, and response characteristics to cope with specific natural hazards. It is a measure of capability of this set of elements to withstand events of a certain physical character (def. Weichselgartner and Bertens, 2000). In Fuchs, S., Heiss, K. & Hübl, J. (2007). *Towards an empirical vulnerability function for use in debris flow risk assessment.* Natural Hazards and Earth System Sciences 7(5): 495-506.

[17] Dellagiacoma, F. (2010). *Summary of the 1st Preparatory Workshop: Hydrogeological risk in the alpine environment.* Third Alpine Water Conference, Venice, Italy, 25th-26th November 2010.

Next to this increased vulnerability, people tend to overload Public Authorities with even greater responsibilities -always asking to the public sector the higher protection from natural hazards- (Zischg, 2010), whereas they are reducing their sensibility, their self-responsibility and their memory concerning the risks (Giannella & Vittori, 2010) [18], trusting in technology and underestimating the strength of the nature (Rigon, 2010). Because of this, the participation of all stakeholders and the public is a key element for successful risk management (Zischg, 2010).

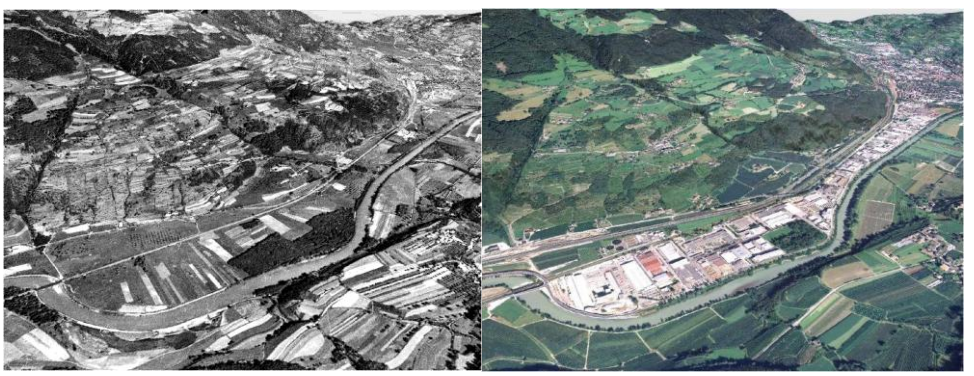

Figure 1.5 – Example of land use change in the alpine territory, near Bressanone/Brixen (Zischg, A. P. 2010, images from TirolAtlas)

Debris flows in the Alpine region (based on the speech of Armanini A, 2010. *Debris flows in Alpine areas.* Third Alpine Conference, Venice, 25th-26th November 2010)

Debris flows are basically a transposition of sediments, in which large quantities of water and sediments can be moved and shifted in a very short fraction of time. This kind of phenomena is often neglected or underestimated by legislation. It is fundamental to clarify that between the sediment transport and debris flows there is a big difference. The first phenomenon is limited in a certain sense and does not have an impact on flows and their speed, whereas the second phenomenon is going to alter substantially the water flow and speed as well as alter significantly the level of risk which is related to this kind

[18] Giannella, G., Vittori, E. (2010). *Comparison of the legal framework on the evaluation and management of natural hazard.* Third Alpine Water Conference, Venice, 25th-26th November 2010.

of event.

There are many important problems that have to be solved in order to understand how to do proper evaluations and decide how to reduce dangerous consequences. The first aspect relates to the instability of certain slopes and the difficulties of prediction, which enable the realization of a case history of the events occurred over the years and the risk perception by local populations. E.g., debris flows may be provoked not only by long-lasting rain episodes but also by subsequent heavy phenomenon which saturates the soils triggering their stability and compactness. The second aspect concerns the huge quantity of materials transported, which make the situation particularly difficult to be managed, because of soil instability. The third aspect concerns the velocity and the dynamic impacts of debris flows: in fact the amount of water is able to shift boulders of huge size, creating problems in terms of impact and changing also the local flow dynamics. E.g., boulders can stop the water overflowing creating dams and subsequent hazardous floods events.

Unfortunately, the *Flood Directive* dedicates just a paragraph to debris flows risk and their related information which may be considered as useful in terms of debris flows occurrence. The carrying out of proper mapping of risk zones, thanks to mathematical models, may represent a possible response to face this issue, paying attention on the effectiveness of the analytical tool which has been chosen. The ranges of possible actions which may be executed are different but often difficult and complicated to be settled in. In fact relocation of settlements may involve a too large extent of population, whereas real time warning may produce also in "false alerts", considering that from the moment in which the phenomenon becomes dangerous to the moment in which the phenomenon is going to happen it can take a long time, undermining the credibility of the system.

1.2 Strategies for risk management

"Integrated risk management" encompasses, in general, all the measures which contribute - in a coordinated way – to reduce damages caused by natural phenomena: prevention measures, early-warning-systems to implement during and after the event, as well as recovery operations of possible damages caused

by the event and the rebuilding (figure 1.6). All the activities are necessary to maintain a certain security level with regard to risks posed by natural hazards to humans and their infrastructures. The solutions on which to act are those that offer the potential for an integrated approach.

Figure 1.6 - Integrated risk management circle (ClimChAlp, 2008)[19]

[19] ClimChAlp, (2008). *Climate Change, Impacts and Adaptation Strategies in the Alpine Space*. Interreg III B Alpine Space Project. Common Strategic Paper. Available from: www.climchalp.org.

Thanks to this definition we understand how the risk management is a complex issue based on an holistic approach which involves subjects with different functions and competencies: Public Administrations, technicians, Civil Protection, forest rangers, business sector and private one, citizens. Obviously only through a good coordination between all parts involved and the exchange of information and experiences is possible to plan a good strategy for risk management and applying efficient prevention measures.

In particular regarding hydrogeological risk in mountain areas, prevention actions can be classified in two main categories: *structural measures* and *non-structural measures*.

In both cases to make effective these measures is very important an exhaustive knowledge of the territory and of its dynamics. In the definition of a strategy for risk management is not possible to ignore a reconnaissance of risk-prone areas and their classification by level and typology, actions which however are fundamental tasks also of *Floods Directive* 2007/60/CE.

The risk linked to a natural phenomenon is related to the probability that a certain event will happen (statistically calculated by the return-times) and to the potential damages caused by the event; constructing a risk matrix based on these two parameters is possible by mapping zones according to the level of risk and the risk typology, identifying the structures exposed to dangerous natural phenomena and deciding which prevention measures undertake (figure 1.7).

The assessments of areas predisposed to hydrogeological risk can be developed using different methods based both on data and experiences of events happened in the past and by using forecasting models which take into account weather parameters (intensity and duration of rains) and geomorphological characteristics (gradient of slopes; pedology and rocks-status; type, cover and use of soils) [20].

[20] The hazard is defined in scientific researches in different ways with different meanings. The most accepted in relation to natural phenomena is the one proposed in the report of UNESCO of 1984, according to that, the hazard is defined as "probability of phenomenon occurrence potentially dangerous in a specific period of time and in a certain area".
The definition of danger involves the concept of natural phenomenon's spatiality and temporality and marginally the concept of intensity or magnitude, namely the size and the destructive power of the phenomenon.

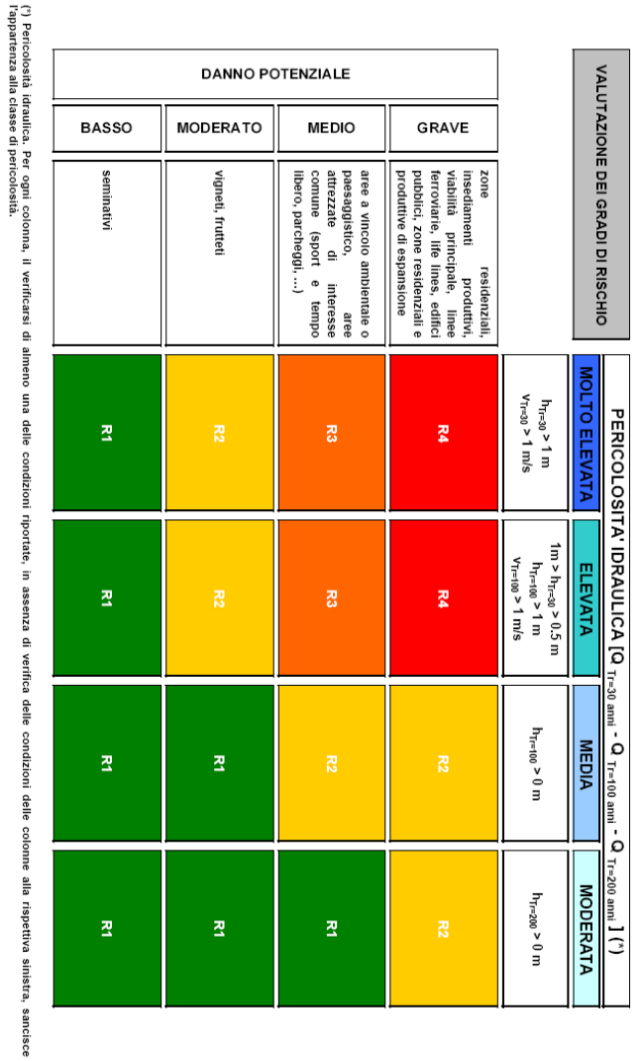

Figure 1.7 - Matrix for hydrogeological risk mapping (Guarino L. 2010)[21]

Some authors have defined the danger such as the probability that a phenomenon of a certain intensity occurs in a certain period of time and in a determined area.

The valuation of danger can be done with different methods:

- Heuristic methods based on subjective and qualitative estimates;
- Statistical methods based on study of statistical relations between control factors and danger;
- Deterministic methods based on functions which produce an hazard model starting to physical-mechanical rules.

Source: ISPRA on-line glossary

[21] Guarino, L. (2010). *From the transitional plan for the Hydrogeological System to the flood risks*

The Countries of the Alpine arc have made huge progressin the field of mapping areas subject to hydrogeological risk, even if maps are not always directly translated in bonds of use in land planning. However there is the need of a more and more intense coordination between all parts involved in order to have comparable valuations based on standard data (for example according to INSPIRE methodology[22]), and for these reasons it is important a close collaboration between Alpine regions to share experiences, methods and database, and also for the continuous updating of these tools.

Structural Measures

Structural prevention measures include the realization and maintenance of all the hydraulic engineering works built to limit damages that could be caused by dangerous natural events at structures and people (controlling peak discharge flows; regulating floods; stabilizing slopes; defending buildings and infrastructures from floods, landslides, rock falls and avalanches). Anyway, this types of measures (embankments, dams, protective walls, lamination canals and basins, stabilization of slopes, etc.) cannot be always applicable and continuously potentiated (Eichenseer, 2010)[23].

In integration to "traditional" engineering works, other typologies of hydromorphological interventions aiming have been applied at increase the space for rivers along the watercourses and to the re-naturalisation of the waterways. These techniques have the objective of regenerating river areas in order to restore and renovate their natural functions without compromising for that reason human activities (Eichenseer, 2010).

The active and passive works of defence from hydrogeological instability phenomena and floods usually have very high costs due both to building stage and maintenance operations[24]. For this reason sometimes their cost is overall

Management Plan. Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.

[22] Available from http://inspire.jrc.ec.europa.eu/ - http://www.inspire-geoportal.eu/

[23] Eichenseer, E. (2010). *Strategies For Flood Control: Our Answers For Future Challenges*. Third Alpine Water Conference, Venice, Italy, 25th-26th November 2010; on this issue participated to the discussion held in Venice Mr. F. Puma, Secretary General of the Po River Basin Authority, supporting this point of view.

[24] Considering the possible increasing frequency and intensity of events, it is vital that existing and planned protective measures be reviewed in terms of the conceivable overloading of

higher than those buildings they intend to protect: in these cases the displacement of at-risk buildings and settlements represent a possible alternative.

The re-location of buildings at risk is a very complex –and not always applicable- choice, but in many situations can be a goal; this difficult choice has to face with the people's attachment to their homes (the social cost of this attachment should be considered) and the belief by many citizens that modern techniques could cope any type of natural event. Some positive experiences in this sense are been carried on in Veneto, where the most consistent delocalization intervention is that which concerned some buildings interested by the Lamosano landslide near Chies d'Alpago, in the province of Belluno (Baglioni and Carraro, 2010)[25].

Non-structural Measures

Non-structural measures generally include organizational measures (e.g. emergency planning, early-warning-systems, control-strategies) and limitations and regulations of the land use (e.g. land use planning, protection and sustainable long-term management of forest ecosystems).

Land use planning is a key-prevention-measure aiming to avoid or reduce risks forbidding settlements in the hazard-prone areas (individuated by the hazard maps), preserving flood-routing basins and corridors and avoiding the excessive waterproofing of soils (Eichenseer, 2010).

However, past experience has shown that it is extremely difficult – occasionally even impossible – to try to maintain existing natural hazard-related risks at their current level using spatial planning tools, but all the possible efforts have to be pursued (Greminger, 2010).

Protection and management of protective forests' ecosystems is a measure which requires few costs and ensures good results such as the increased stability of slopes, a major precipitations absorption and an increase of concentration time.

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protective structures, also taking into account the uncertainties due to climate change. Particular attention must be paid to the maintenance of protective facilities.

[25] Baglioni, A. and Carraro, M. (2010). *Delocalization of settlements: extreme intervention or priority*. Third Alpine Water Conference, Venice, Italy, 25th-26th November 2010.

The acceptance of this type of limitations is facilitated by a consciousness raising of the level of risks by all parts involved through that is defined "risk dialogue"[26].

Still technological development and concentration of the most part of responsibilities on public subjects have brought in the last years to a loss of sensitivity and individual responsibility of individual citizens, that however requires increasing protection levels. A greater risks consciousness and a deeper knowledge of preventive actions which can be implemented help limiting undesirable behaviours and minimizing damages both in economic terms and human lives during catastrophic natural events. It is therefore necessary to start activities to spread a risk culture linked to natural events. In this regard, a dialogue on effective risks contributes to maintain a collective memory of risks which differently tends to weaken fast.

Other non-structural measures concern the implementation of monitoring systems (at the moment rather weak in some Countries of Alpine arc) and early warning systems; scientific and technological tools in this field are more and more sophisticated (satellite measurements, laser-altimeter measurements, ground measurement network, mathematical models, massive treatment tools of heterogeneous data, statistical and dynamic models) and allow an evaluation with a reliability degree never registered before, but they can't and wouldn't completely replace field observations (Claps, 2010).

However, the precision of these models depends on amount and quality of data used for simulations; for example experiences show how induced hazards by intense meteorological events take on different characteristics depending on the spatial scale at which they occur.

River basins of hundreds of thousand square kilometres react to the flood waves in a time-span greater than 24 hours. Differently, the uncertainty on reaction forecasts to precipitations in small-size hydrographical basins (<100 km^2) is high both because of the very quick outflow (minor concentration time:

[26] Risk dialogue should help to inform the Authorities, politicians and society about the need for a concerted preventive effort. It is fundamental to achieve risk-appropriate decision-making when planning safety measures and when prioritising the corresponding investments. A sound risk dialogue also allows participative decision-making processes. Risk dialogue could also favour (as a reverse process) the consciousness of risks of technicians and politicians thanks to the traditional knowledge and heritage (PLANALP, 2010).

4-6 hours) and because meteorological data refer most of the time at different sizes of synoptic scale - concentrating on wider scales; thus both difficulties in hydrogeological and meteorological modelling occur (Casarin and Giuriato, 2010)[27].

Thus, monitoring systems must be set up to keep risk situations under observation. These systems offer an important mean of communicating risk also promoting knowledge and ensuring risk-appropriate land use via targeted training and, furthermore, promoting and supporting the early recognition of potential hazards that are influenced by climate change (such as avalanches, flooding, mudslides and landslides).

Residual risk

Assessing natural hazards and the probability of their occurrence is an extremely demanding task. It always involves a degree of uncertainty linked to forecast accuracy. It is thus clear that incidents cannot be predicted exactly, neither can absolute protection from natural hazards be guaranteed: therefore, despite are adopted the whole possible and acceptable prevention measures, an absolute security level isn't achievable. In fact there is always the so-called "residual risk".

The term "residual risk" is often defined as the risk that remains after all protective measures have been implemented and it is closely related to the question of which level of risk is accepted by the individual or by society. The term cannot be defined in an unambiguous sense, it has more components and is composed of unknown and unpredictable risks (e.g. out-of-scale events), unrecognised risks, risks which are deliberately taken and accepted (everything can't be protected), negligible risks, risks caused by inappropriate safety measures (technical failure)[28].

The assessment of residual risk is becoming increasingly important given limited options for incorporating natural hazard risks created by climate change into an adaptation strategy. Nevertheless, the continuous evolution of mountain territory with increasing land shares used to infrastructures,

[27] Casarin, R. & Giuriato, F. (2010). *Hazards and risk aspects on the Upper Adriatic river basins.* Third Alpine Water Conference, Venice, Italy, November 25th-26th, 2010.
[28] PLANALP (2010).

settlements and ski resorts and the effects of climate change on return-periods of hazardous events make residual risk quantification more difficult, but a greater risk consciousness by citizens can certainly contribute in reducing its effects (Greminger, 2010).

1.3 The legal framework

Outlining the regulatory framework relating hydrogeological risk management is a quite complex operation, because in this sector the legislation is evolving and involves different Institutions and competences.

At the European level the main legal points of reference on water are Water Framework Directive 2000/60/CE and Floods Directive 2007/60/CE.

These two directives offer the opportunity to change the approach that in the past ruled the planning of activities for the protection from floods, making that these were not limited only to settlements protection, but could contribute more and more to the achievement of rivers good quality or, at least, they don't contribute at their deterioration (Giannella & Vittori, 2010).

In particular the *Floods Directive*, that it applies to all inland waters and coastal waters, require Member States to:

- assess if all water courses and coast lines are at risk from flooding;
- map the possible flooding areas and the risks to assets and people in these areas;
- take adequate and coordinated measures to reduce this hazard.

To achieve these aims, the Directive give the measures that every Member State will need to develop and the deadlines within which carrying them out:

1. carry out a preliminary assessment by September 2011 to identify the river basins and associated coastal areas at risk of flooding;
2. draw up flood risk maps for such zones by June 2013;
3. establish flood risk management plans focused on prevention, protection and preparedness by June 2015.

Moreover, in the Directive is reiterated that the fulfillment of these obligations will not put aside the need for a greater coordination and cooperation between the Member States in order to avoid for example that the measures adopted in

a Country will increase the flood risk in those near. In second place it is also, hopefully, an effective collaboration with other Countries, according to what already provided for the Directive 2000/60/CE and for international principles of floods' risk management. These objectives are substantially integrating the approach based on the Italian Law 365/2000, adopting the Hydrogeological Structure Plans (Piani di Assetto Idroeologico, PAI) – introduced by the law 180/1998-. However, differently from the Italian Legislation, the EU 2007/60/CE is more focused on the flooding events, rather than to the phenomena affecting the higher basins, such as debris flows, mudflows, bank's erosion, solid material's transport; with the Decree of adoption in Italy of the EU Directive (Decree 49/2010), a part of the mountain peculiarities has been re-introduced (Casarin and Giuriato, 2010).

The Directive implementation in the Alpine area will be facing with the complex administrative framework of the interested Countries, in which hydrogeological risk management involves a series of Institutions which must coordinate themselves (see table 1.2).

In general, the responsibilities mostly lay in public institutions, and in particular on municipalities – where the technical knowledge is generally low. Thus, rather than coordinate, National and Regional Institutions must enhance the support to municipalities.

Table 1.2 - Institutions involved in hydrogeological risk management in the Alpine countries. (Giannella, G. & Vittori, E. 2010)

	ITA	GER	FRA	AT	CH	SLO	FL
National level (Framework setting, subsidies, partly operative on local level)	**Ministry of the Environment, Land and Sea** **Civil Protection**	**Federal Ministry:** sets framework	**Min. of Env. MEDAD:** sets framework maps and plans (PPR) **National Forest office RTM (**Mountain Terrain Restoration Service): maintenance	**Fed. Ministry:** sets framework **WLV** (Torrent and Avalanche Control) **BWV** (Federal Water Management Agency)	**Federal Ministry:** sets framework, subsidies	**Ministry:** Sets framework and plans, subsidies **PUH** Torrent and avalanche Service Geological Service	**National Administration** (Forest, Geology, Spatial Planning): Planning, Consulting, Subsidies
Regional level (Technical knowledge Planning Subsidies, Partly operative on local level)	**Regions and Autonomous Provinces**	**WMA** (Water Management Agency) realiz. & maint. of prot. struct. (rivers of 1st and 2nd order) **State forest admin.**	**Préfet** , département, Régions: Regional Directorates for the Environment (DIREN)		**Cantonal administration** (Forest, Geology, Spatial Planning), Planning, Consulting, Subsidies		
Local level (Direct responsibility operative)	**Municipality Direct responsibility**	**Municipality Direct responsibility** Realiz. & maint. rivers of 3rd order **Fire Brigades, Police**	**Municipality Direct responsibility**	**Municipality Direct responsibility**	**Municipality Direct responsibility**	**Municipality Direct responsibility**	

The Italian legal framework

Until 2006, the main legislative activities with regard to soil defence in Italy were prescribed by the Law 183/1989, the Law by Decree 180/1998 and the amendments thereof (converted into law by Law 267/1998).

Law 183/1989 introduced the holistic approach in natural hazard and risk

management by considering different sectorial topics in a hydrographical basin. These hydrographical basin are delimited by geomorphologic and topographical elements and not by administrative borders. This Law has lead to the institutionalisation of the watershed management authorities, the so-called Basin Authorities. After the institution of the river basins, these Authorities had assumed either Regional, interregional or National competencies.

The Law 180/1998 establishes also the Extraordinary Plans and the Hydrogeological Structure Plans (PAI), which impose to River Basin Authorities risk zoning and limits to land use for risk mitigation.

The Ministry of the Environment Land and Sea has identified the risk-prone areas in all the PAIs prepared by the Basin Authorities, with the following results:

1) over 500,000 critical situations;
2) over 6,600 municipalities (82% of Italian municipalities) including zones at high risk from landslides, floods or avalanches (a 10% of the national territory is threatened by high-risk situations);
3) over 11,000 interventions needed to achieve acceptable safety conditions.

The division of responsibilities and competencies between National, Regional, Provincial and Local Authorities is described by the Decree 112/1998. After this Decree, the National Authorities are responsible for coordination, setting up of criteria, guidelines and standards and for the programming and the financing of protection and intervention measures. The Regions are responsible for the planning and realisation of protection measures and for the maintenance of the protection structures.

The Law by Decree 96/1999 describes how the Regions (NUTS-2) assign the responsibility for these tasks to the Provinces (NUTS-3). The Decree 180/1998 introduced the risk based land use planning and the risk-based decision making for protection measures. Also the aspect of the vulnerability of exposed goods to natural hazards was introduced by this Decree. With this Law, Italy was the first nation in Europe introducing the risk concept in land use planning and in the prioritization of the planning of protection measures.

In 2006, the General Law for the Environment (Decree n.152, 3rd April 2006) drafts a reorganisation of the Basin Authorities. These institutions will be changed in Basin Districts. Until now, the reorganisation has not been

implemented. The Basin Authorities continue their work, fulfilling the implementation of the European Directive 2000/60 in Italy. The implementation of the EU Water Framework Directive in Italy is described by the Law 13/2009 (Giannella & Vittori, 2010) (see the box at the end of the chapter).

The Civil Protection –which depends directly by the Presidency of the Council of Ministers- mostly realizes the emergency plans, manages the national alert system and the functional centres (the key-elements in the networks of alert and emergency management, weather forecast, monitoring and modelling), but also works in the prevention phase by means of information campaigns (based on Laws 183/1989, 225/1992, 401/2001 and Law by Decree 112/1998).

The prevention of the avalanche risk is mainly based on the Regional level, also with the involvement of the Civil Protection (Giannella and Vittori, 2010).

1.4 How to deal with hydrogeological risk: local experiences in the application of legislation

In order to have a proper implementation of the laws and the directives at a local level, planning is a fundamental task. Planning strategies have to be founded on a wide framework of knowledge (long-time-monitored data, models, maps and studies, on-site experiences) to answer the models established by legislation and to be tailored on the different scales of analysis.

Regarding the application of the *Flood Directive* in the Basin Authorities, it should be noted that following the law 152/2006 they pass from a purely national regulation (Law 183/1989) to a legal system closer to the one imposed by European regulations (in particular 2000/60/CE and 2007/60/CE).

The Basin Authority of the River Po is the biggest in Italy, called upon to manage a widespread embankment system calibrated on return events of about 200 years (even if the residual event of overflow or banks breaking has a return time of 500 years). In mountain and valley bottom areas (58% of the total territory), the maps consider different levels of dangerousness and instability and come from a reconnaissance sweep of all the existing cartographies at the moment of preparing the Basin Plan (approved in 2001). The resulting cartography is then shared with municipalities to guarantee

adapting and updating of local town planning, also by the tool of the Territorial Plans of Provincial Coordination (PTCP). Ten years after the entry into force of the Basin Plan, about 39% of municipalities has complied with the adjustment. The increased percentage of areas considered to be in hydrogeological distress (from 9% to 14%) is also mainly due to enhance accuracy and precision in the valuation process of the same[29].

As required by *Water Framework Directive,* Basin Districts, at least theoretically, have been established; the Basin District of Eastern Alps unifies the Basin Authorities of Adige, Northern Adriatic and the "minor" ones. The Basin planning is particular because of the different planning levels that intersect, also meeting the autonomies of the Provinces of Trento and Bolzano[30] and the existence of PIGUAP[31]. In the Venetian part, the Management Plan for the Protection from Hydrogeological Risk (*Piano Stralcio per la Tutela dal Rischio Idrogeologico*), in force since 2006, born on the basis of a great public consultation and participation and contains the perimeter of the hydraulic and hydrogeological risk areas, the identification of risks and of possible countermeasures, the implementing rules and regulations for areas at risk, with 1:10.000 maps and return periods considered to be 30, 100 and 200 years.

The Legislative Decree 49 of February 23rd, 2010 transposes the Law 2007/60/CE, characterized by the imposition of tight deadlines; the application site of these provisions will be precisely the Basin District Authorities. Outlining the plans for flood risk management it is also considered important to take into account environmental objectives regarding water quality and nature conservation imposed by 2000/60/CE as well as by DLGS 152/2006. The flood risk management plans are of course superordinated both to town planning and emergency planning (Guarino, 2010).

In the Province of Trento are in force the Geological Synthesis Paper (*Carta di*

[29] On this issue participated to the discussion held in Trento Ms. C. Merli, from the Po River Basin Authority.

[30] The Legislative Decree 463/99 gave full autonomy to the Autonomous Provinces of Trento and Bolzano regarding the Basin planning and therefore also on the hydrogeological risk.

[31] The General Plan of Public Water Use (PIGUAP) was approved in Trento in 2006 including a classification and delimitation of hydrogeological risk areas. In the Province of Bolzano, while its approval is still ongoing, is being established, starting from the municipal base, the Hydrogeological Structure Plan.

Sintesi Geologica) since 2003 (1:10.000), attached to the Provincial Urban Plan (*Piano Urbanistico Provinciale, PUP*), and the Map of Hydrogeological Risk (*Carta del Rischio Idrogeologico*), enclosed to General Plan of Public Water Use (*Piano Generale di Utilizzazione delle Acque Pubbliche, PIGUAP*), regarded as a hydrogeological risk map which regulates the risk management.

The latter is a management tool of water resources, adopted in agreement with the State and in force in the Province of Trento since 2006, which corresponds to a local basin plan. Its forecasts and requirements are guidelines for all tools of territorial planning (also for the PUP). Both papers and maps have as guiding principles the land protection and people safety, but living together is not easy: each urban transformation has to deal with both instruments.

According to the experience of Trento, the Hazard Map (*Carta della Pericolosità*) represent an efficient tool for land control and management, whereas the Risk Map has shown some difficulties, also because it is a derived map, difficult to read and not able to define adequately phenomena and their position.

Therefore, the Autonomous Province has defined a new conceptual plan, through the definition of the degree of danger, to bring at the delimitation of the areas of risk and the urban control. This new conceptual plan found a place in the new PUP adopted in 2008 that defined a new Synthesis Paper of Hazard (*Carta di Sintesi della Pericolosità*). The Synthesis Paper of Hazard replaces completely the Geological Synthesys Paper (*Carta di Sintesi Geologica*), by shutting down the application of PIGUAP on land use. In this context, regarding the torrents and rivers' phenomena you refer to return times between 30 and 200 years (Fait, 2010) [32].

In the Autonomous Province of Bolzano has been chosen to favour as far as possible the local planning. The risk areas planning was attached to the strongest planning tool in Alto Adige, that is the municipal one, differing from the nearby reality of Trento. In the Province of Bolzano the risk planning completes (and surpasses, if necessary) the Municipal Urban Plan. The Province is interposed as the main organ of control, as well as financial backer. The procedure was inspired in part by the Swiss method, very advanced in this

[32] Fait, S. (2010). *The maps of the hydrogeological dangerousness "fluvial and torrent phenomena"*. Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.

regard, and by the system that binds resulting from the Italian structuring. The main disadvantages of this approach, however, relate to the risk of employing a methodology that is not unique, in which results are partial, while there should be necessary more targeted interventions at supra-municipal level (Macconi, 2010) [33].

Valle d'Aosta Region spends every year 35-45 million euro for soil and land protection. In the Autonomous Region is avoided as much as possible the use of models, then the hazard maps (realized by Municipalities and approved by the Region) are drawn mostly on the basis of geomorphological considerations. The hazard valuations are based on a hazard classification: low, medium (forbidden to build), high (forbidden to build). The hazard maps consider landslide, floods, debris flow and avalanches (Rocco, 2010)[34].

In Friuli-Venezia Giulia the sensitivity to natural hazard is long standing, particularly due to the flood of 1966 and the earthquake of 1976. By the end of the 70s in the Autonomous Region was approved a law requiring municipalities to equip with urban instruments such as the geological report, to submit after at the screening of regional bodies. In this way, over the years a hazard map has been created which proved to be a knowledge base farsighted and well designed. But with the Decree 180/1998, the realization of the Hydrogeological Structure Plan (PAI) has been entrusted to Basin Authority with which it was not easy to manage the issues in this regard, because it is a body that is characterized by a more comprehensive and homogenous vision than the more particularistic one implemented so far. Consequently, the Region had to adjust the bonds already provided to the new provisions of PAI, which are still late in being implemented. The previous sensitivity has, however, favored an urbanism careful to contain the vulnerability[35].

Outside the Italian borders, a good example is shown by the *Austrian Service for torrent and avalanche control*, in the district of Reutte (North-Western Tirol).

The Federal Constitution (1920) defines that in Austria torrent, avalanches, rock falls and landslides control is a Federal competence, although bigger rivers (e.g.

[33] Macconi, P. (2010). *I Piani delle zone di pericolo in Alto Adige.* Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.

[34] Rocco, R. (2010). *La gestione del pericolo di inondazione in Valle d'Aosta.* Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.

[35] On this issue participated to the discussion held in Trento Mr. R. Schack, from the Region Friuli-Venezia Giulia

Inn) are of a Province competence, causing some interferences. There are two main orders: the first one (1976) defines zones and criteria for hazard zone mapping, the second one (1979) outlines that all the planning and measures are done in the regional site.
Hazard zone mapping in Austria is a basis for internal planning (cost-benefit analysis and ranking measures, according to their urgency) and external planning (land-use and urban planning, building trade and safety management). Maps are composed by a graphic part and a text: in the written part is also described the catchment and risk area.
Recurrent design event are based on calculations made for about 150 years. Precise criteria for hazard zone mapping are chosen for categories like water quantity, erosion, bed-load deposits, slope movements. All possible events and scenarios are considered and included in the hazard zone mapping procedure. Sometimes analytical and administrative problems occur: the first ones concern more with input data, the second ones are caused by the different evaluations realized by Authorities; e.g. Provinces use a recurrent event of 100 years instead of the 150 years considered by the Service of torrent and avalanche control[36].

1.5 Future challenges

Water has always been an important resource and an attractive factor in mountainous areas, but at the same time it deserves careful attention and can represent a risk for human settlements. In the last fifty years significant social changes have led to changes in the way in which soil is used, increased numbers of inhabited settlements, the growth of economic activities, and an increase in mobility and connections – which have in turn increased the sensitivity of territories.

During the programme of the "Water in the Alps" International Conference (and the preparatory workshops to the Conference), among others, the attention has been focused on water as key factor in generating potential hydrogeological risks. Intense or particularly long-lasting meteoric phenomena

[36] Kurz, D. (2010). *Hazard zone mapping of the Austrian service for torrent and avalanche control*. Third Alpine Water Conference, Preparatory Workshop n.1, Trento, Italy, 29th September 2010.

can in fact, and especially if combined with anthropogenic factors (e.g. as the waterproofing of soils and the deforestation of slopes), create conditions that favour natural disasters such as floods, landslides or debris flows. These events are however particularly diffused in the Alpine region and seem intensifying, for frequency and strength, in the last decades, in parallel with increase of residual risk, also due to scientific uncertainties on climate change valuation (Greminger, 2010 and Claps, 2010, in particular see figure 1.2). In fact, climate change is threatening to further accelerate processes; it is therefore necessary to maintain high levels of land protection and further improve prevention and safeguard measures. Anyway, vulnerability has increased, thus, in parallel have increased the damages linked to the events.

Figure 1.10 - Visual effects of a flood in human settlements (Greminger, P. J. 2010)

Is therefore necessary to adopt an integrated approach respect to risk management, which ensures a correct -and not easy- equilibrium between the safeguard of population and infrastructures (on the basis of EU *Floods Directive* 2007/60/CE and of national legislations) and the achieving-maintaining of a good status of all waters (on the basis of EU *Water Framework Directive* 2000/60/CE and of national legislations), bearing in mind that prevention starts

first of all at a planning stage (River Basin Management Plans, territorial and land use planning)[37] and taking into account that non structural / "cultural" measures (land planning, land use, effectiveness of protection forests, etc.) deserve a particular attention, such as the information and involvement of the population to promote responsibility and adequate behaviours.

The long return times to consider (for instance, *Floods Directive* deal with very rare risks, up to return times of 500 years[38]) add uncertainties to the complexity of the situation, making both statistical and physical evaluations very complex to characterise (Armanini, 2010).

In this framework, residual risks become relevant. This shall promote a widespread social dialogue in case of out of scale events which may be beyond the scope of projects.

Science and technology can certainly provide highly sophisticated tools to evaluate hydrogeological hazards and to monitor and foresee phenomena which are always very complex and dependent on factors which sometimes cannot be detected with sufficient accuracy.

Prevention of hydrogeological risks in mountain areas is the result of the integration between hazard evaluation, the analysis of the event, of the land structure and of threatened elements, of repair and protection measures and of civil protection resources. Also, cooperation among Alpine Countries and Regions is important, as it allows to compare different organisational models and experiences, and to rely on a wider database. These Public Administrations have made different choices in terms of risk analysis: some have chosen to carry out analyses and draw maps themselves, ensuring methodological consistency and a tighter control on the process of definition of areas; others have entrusted municipalities with the task of drawing risk maps, while Regions (NUTS-2) are responsible for defining guidelines and producing reference materials. For the future it would be important to make all the necessary

[37] In the framework of the Alpine Convention the need of a "Water Protocol" or not has been discussed for a long time, concluding that the identified challenges can be tackled by making use of the existing instruments. Thus, rather than producing a new water specific piece of legislation, for the Alpine region at this stage it is of major importance to ensure that implementation efforts of the existing rules are continued and intensified.

[38] According to the Italian Decree 49/2010, as highlighted during the discussion time by Mr. A. Rusconi, from IUAV, Venice.

efforts in order to translate the risk analysis into binding hydrogeological regulations (that are practically guarantees for the population) in urban planning, also taking into account the uncertainties linked to climate change, thus favouring the risk prevention by non-structural measures which should avoid increases (or even reduce) in vulnerability levels.

Concluding, the main tasks for the future will be:

- to ensure the long-term provision of the resources needed for integrated, holistic natural hazard management and to promote and support integrated risk management;
- to pay a great attention to the prevention of natural hazards, being in this field the cost-benefit relation of about 1:100 (Rigon, 2010);
- to ensure the proper implementation and reinforce implementation means of existing legislation and in particular: to follow up the implementation of the EU *WFD* (2000/60/EC) with the focus on hydromorphology and according to the EU *Flood Directive* (2007/60/EC);
- to quantify in more detail effects of climate change (also enhancing the networks of monitoring systems);
- to avoid as much as possible to construct new buildings in areas depending on the protection of technical structures and to avoid reducing hazard zones only on the basis of building of protective structures (Giannella and Vittori, 2010);
- to improve the protection and long-term management of the protection forests (which is an investment with an high-efficiency value), to favour non-structural measures despite structural ones and to consider the spatial variability of the effects of climate changes to natural hazards in risk management practice (Zischg, 2010);
- to take into account in the design phase to tailor protective structures on greater flows (up to 5-6 times more) in order to consider sedimentary transport (Rigon, 2010);
- to enhance the risk dialogue between Public Authorities, scientific community, stakeholders and public, highlighting the consciousness of risks and the concept of residual risk (Giannella and Vittori, 2010).

The legal framework and the application of the Water Framework Directive in Italy

The implementation of the Water Framework Directive imposed a reorganization of the geographic and administrative management of European water resources, implying for the Member States the predisposition of suitable facilities and the gradual achievement of the objectives, in accordance to an ambitious roadmap. The Directive represents the most far-reaching and complex legislation emanated from those in the environmental field in recent years. It involves a considerable amount of changes in the European hydro sector, setting high environmental quality objectives for both surface waters and groundwaters, to be achieved by 2015. Then, one of the distinctive features of the Directive is, as anticipated, the allocation of water river basin districts on the basis of catchment areas and the identification of the authorities responsible for the preparation of River Basin Management Plans (RBMPs).

Before the implementation of the WFD, the water sector in Italy, more than others, has been characterized by a phenomenon of lawmaking that has created problems of overlapping responsibilities and fragmentation of decision making power. This innovative application was trying for the first time a holistic redefinition of issues relating to soil conservation, water reclamation, rational use and management of water resources, which could allow an economic and social development and the protection of related environmental aspects. The law also laid the foundation for the creation of a government "wide-scale catchment area", intended to bring together expertise, regional and provincial centres of the management of land and water. The Italian territory was in fact divided into hydrographic basins of national, interregional and regional interest, as listed by the Art. 14 of the Law.

River basin authorities designed by the Law 183/89 have been for years the place for discussion and consultation between State and regions on these and other important issues: the Basin Plan, drawn up by individual thematic experts, represented the summary of this decision-making process. However, the Directive has identified in the management plan of the district a more operational and articulate tool than the previous one.

The major difficulties in the application of the WFD in Italy are due to their

transposition in the Italian legislation, namely to the complex formulation of the Part III of the Legislative Decree 152/06 (D.Lgs 152/06) and to the effects of decentralization process of administrative functions from the state to regions and local authorities.

The Decree that implemented the WFD in Italy abrogated almost all the previous legislation on water, with the aim of simplifying the complex existing framework. In particular, it envisaged the abolition by April 30th 2006 of the River Basin Authorities in order to give the new eight District Authorities established by the WFD the planning functions of the uses of water resources. However, the Decree was not emanated and, in order to solve the situation on a provisional basis, pending the conclusion of the process of environmental review and correction of the Decree, another corrective decree has brought again to life the suppressed Authority Basin.

In February 2009, the Law n°13, in order to comply with EU obligations, extended the activity of the Basin Authorities (Law 183/89) and have attributed to Basin Authorities of national importance the task to coordinate the compilation of plans for district management. One year later, in February 2010, the institutional committees of the River Basin Authorities of national importance adopted Management Plans, respecting the EU deadlines, although without solving the problem of the formal establishment of the District Authority. In the mean time, Italy transposed through the Legislative Decree February 23rd 2010, n° 49, the Floods Directive (2007/60/CE), identifying in the same River Basin District Authorities (established by the art. 64 of Legislative Decree 152/06) the responsible authorities for drawing up the Plan of Flood Management. Law n° 13 was aimed at permitting the predisposition of Management Plans established by the WFD and, despite it was provided for the extension of the activities of Basin Authorities (former Law 183/89), it did not confer to old Authorities the functions of an Authority District with respect to the implementation of 2000/60/CE and 2007/60/CE Directives.

Law n° 209 of December 10th 2010 (art.4), in order to solve this impasse, gives the River Basin Authorities of national importance the coordination role in river basin membership, including the:

- update the Management Plan of the District, provided by 2000/60/CE Directive;

- update the Management Plan of the Risk of Flooding, provided by 2007/60/CE Directive.

The complex formulation of the Part III of the Legislative Decree 152/06 (D.Lgs 152/06), also called TUA (Environmental Code - Testo Unico Ambientale), has created some disagreement in the relations between State and regions in water sector and soil conservation, especially on issues of great importance for the decentralized administrations, including the breakdown of national territory in eight river basin districts and their relevant regulatory framework.

The above mentioned reform comes to light in a already changing scenario, primarily due to the reform of the Title V of the Italian Constitution and to the subsequent conflicts arising between State, Regions and Autonomous Provinces with regard to the division of expertise in the areas listed by art. 117 of the Constitution, especially those insisting in preserving a good environment. These conflicts have increased exponentially with the approval of the TUA and in particular with the rules which delineate the functions of various institutions. Indeed, Part three, entitled "*Norme in materia di difesa del suolo e lotta alla desertificazione, di tutela delle acque dall'inquinamento e di gestione delle risorse idriche*" (Rules on soil conservation and combating desertification, protection of water pollution and water management) was often contested by the regions that have seen their own role marginalized with respect to the organization existing before the reform. Nevertheless, the Constitutional Court has rejected their appeals, since the functions are related to the environmental protection, namely the sphere of exclusive exercise of State power. This thin line between use and protection of the environment and between regional and state competences and the consequent delimitation of powers has created a conflict in terms of institutional management and protection of water resources.

Finally, this has complicated the development and approval of Plans for river basin management, the instrument identified by the WFD to be implemented in the management of water resources (art. 13), showing a lack of coordination between different levels of decision-making.

The governance of water resources is proving a real test for the models adopted or which will be adopted in Italy. In this specific case, the division between the State, the Regions and the local authorities drawn by the new Title

V of the Constitution and specified by Part II of the Environmental Code, increases phenomena of competition and contrast between all the parties involved. The empowerment of dialogue and interaction between central authorities and local-regional representations, as well as the implementation of organizational connections between them, is desirable in order to continue on the path to improving water resources management.

Another aspect to be taken into account is the transfer of state assets to the regions and local authorities prefigured by the Decree on the so-called "*Federalismo demaniale*" (the implementation of federalism to state-owned properties), which constitutes the first concrete act of the process of implementing art. 119 of the Constitution, set out by the Enabling Act (*Legge Delega*) on fiscal federalism (Law n° 42, 5th May 2009). Among the properties taken into account are those of the maritime and hydro domain and those belonging to the hydraulic engineering and reclamation under state jurisdiction (with the exception of rivers and lakes of supra-regional context). In order to implement a transfer with no charge for the hydro domain, the State adheres to the criteria of territoriality, subsidiarity, adequacy, simplicity, financial capacity, correlation with powers and functions and environmental protection. This measure, justified by the need to provide regional and local authorities with a heritage that may partially remedy to the current State deficit, should however pay attention at avoiding an increase of the fragmentation of the management of water resources. What is actually emerging is therefore the risk of an increase in the fragmentation of ownership of water resources, which would probably go against the trends of the decisions taken in the WFD.

2 RIVER BASIN MANAGEMENT PLANS IN MOUNTAIN ECOSYSTEM*

* Text reviewed, based on the presentations exposed at the 2nd session of the 3rd International Conference "Water in the Alps", Venice, November 25th and 26th, 2010, and at the Preparatory Workshop n.2 "River Basin Management Plans as an instrument for the safeguard of the alpine mountain ecosystem", Turin, October 13th, 2010.

2.1 Main impacts and pressures on water bodies located in Alpine areas

The Alps are widely known as the "water tower" of Europe as they contribute to a disproportionally high share of water to the European water balance. Furthermore, the Alps are still one of the largest continuous areas on the continent with outstanding unique and diverse natural habitats. Evermore growing pressures caused by man are increasingly threatening this heritage and the ecological functioning of watercourses. For these reasons particular care should be used in the coming years to prevent the habitats deterioration and to recover those that are in bad conditions.

It has clearly been demonstrated in the 2nd Report on State of the Alps (RSA II, 2009)[39] that a broad range of pressures and impacts affect water and ecosystems within the Alpine region; the origin and the extent of challenges for water management are quite diverse within the Alpine perimeter due to differences in climate, geology, topography, land use, the intensity of settlement areas, history and the socio-economic background.

On the basis of the national contributions, the RSA II identifies and provides a clear picture of the major water management issues shared by all Alpine Countries and to be tackled in order to guarantee a sustainable and ecologically sound development of the Alpine area. The main challenges for the future focus their attention on different aspects, such as the nature of the existing planning instruments and their capability to cope with water related issues and whether RBMPs, set by the EU WFD, adequately cover the identified alpine specific issues.

Alpine rivers are extremely dynamic ecosystems, their ecological condition strongly depends on the longitudinal, lateral and vertical connectivity and on the natural variations of the hydrological cycle. Little modifications to the water balance and to the water balance management can lead to significant impacts on the environment. These impacts can also worsen on the light of the predicted climate change effects (Puma, 2010)[40]. Projected changes for

[39] Alpine Convention (2009). *Water and water management issues. Report on the State of the Alps. Alpine Signals - Special Edition 2,* Permanent Secretary of the Alpine Convention, Innsbruck.
[40] Puma, F. (2010). *River basin management plans: opportunities for an integrated approach to*

mountain regions suggest that the European Alps are likely to have slightly warmer winters with more precipitation than in the past, while the summer climate may become much warmer and drier than today. It seems thus that Alpine climate change will lead to changes in the timing and amount of run-off in European river basins and that floods and droughts will become more frequent impacts from different kinds of pressure can be identified by the following three abiotic influencing factors: water quality, water quantity and river morphology and continuity (Isoard, 2010)[41].

While, except for some problems reported mainly for the outskirts of the Alpine region in areas with industry, intensive land use and agriculture, the chemical quality of water in the Alpine area is quite good for most surface waters and groundwater (low level of pollution due to (comparatively) low(er) pressures) more significant are the impacts affecting the water quantity, river morphology and continuity aspects.

The main impacts on the water quantity identified by the RSA II are:

- lack of sufficient residual water downstream the water abstractions, impacting the flow and water temperature regime, reducing the potential range of habitats for aquatic organisms, causing drought and water scarcity,
- hydro-peaking, which flushes river stretches and causes considerable loss of biodiversity,
- alterations in the transport of sediments (higher erosion downstream of run-of-river dams; no/less erosion and bed load transport downstream of reservoir dams and neither further floods) causing corresponding impacts on morphological processes and loss of biotopes apart from potentially falling levels of the groundwater table;
- the transformation of characteristic landscapes and the natural scenery in the case of artificial reservoirs.

In the Alpine system water is abstracted for many purposes: industrial, agricultural irrigation or technical snow production, hydropower generation.

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the water management. Third Alpine Water Conference, Venice, Italy, 25th-26th November 2010.

[41] Isoard, S. (2010). *Climate change in the Alps and the impacts on water resources*. Third Alpine Water Conference, Venice, Italy, 25th-26th November 2010.

This causes that a significant share of river stretches fails to meet the good ecological status due to their failure to meet ecological flow requirements. Moreover hydro-peaking, related to the high level of exploitation/restitution for hydropower production in the Alpine region, puts additional pressure on aquatic life-forms: too little residual flow downstream of the abstraction sites together with hydro-peaking – beside morphological deficits – are recognised as major challenges to water management to achieve the objectives of the existing legal framework[42]. Within the Alpine Convention Area both droughts and water scarcity were experienced only in short periods, and in small sparse areas, so they are not perceived as a major issue. Notwithstanding, in the future, under the predicted effects of climate change their frequencies and impacts is destined to grow.

Even if considering the water cycle for the entire Alpine region the water volumes used for artificial snowmaking are insignificant and although it represents an important adaptation strategy to enhance winter tourism considering the changing climatic conditions, artificial snowmaking can cause important impacts to the environment. In fact, artificial snowmaking can imply temporal water stress rising conflicts among users and also the building of mitigation ponds, despite giving a positive contribution, entails further construction works in fragile environments that in the same manner can imply important environmental concerns.

The same can be said for additional exploitations due to new reservoirs and lakes in the Alpine area that can significantly increase the impact on the ecological conditions. However, reservoirs and lakes have also a significant capacity to act as balancing elements in the water cycle, more than ever they have a role of providing water for downstream areas during dry periods.

Otherwise, the most important environmental issue for the Alpine rivers is the hydromorphology - the interruption of the river continuity, preventing aquatic forms of life (like fish) from migration which is necessary in certain life cycles for reproduction. Natural Alpine rivers are highly dynamic systems which host a wide variety of biotopes in the water, on the gravel banks and in the adjacent alluvial forests: during low water, the water is branched between wide gravel banks, during floods the river forms a braided system covered by water. The

[42] Alpine Convention (2009).

river's hydro-morphological processes encourage the relocation of gravel banks and considerably contribute to the restoration of habitats for animals and plants. During the last century Alpine rivers have been interested by the construction of canalisations, dams and weirs, interrupting the longitudinal and the lateral connectivity/continuity of the river systems, impeding the migration of animals in and along the river, especially that of fish, reducing flooding of the inundation areas, lowering of the groundwater level and causing the loss of biotopes for animals and plants (Goltara, 2010)[43].

Figure 2.1 - Ecological degradation of Alpine rivers: view of the Stura di Demonte river, at Pietraporzio section (Clemente, F. 2010)[44]

[43] Goltara, A. (2010). *The River Basin Management Plans for the conservation and the restoration of the river alpine ecosystems*. Third Alpine Water Conference, Preparatory Workshop n. 2, Torino, Italy, 13th October 2010.

[44] Clemente, F. (2010). *Ricerca di soluzioni per la compatibilità dell'idroelettrico in montagna: il Progetto SHARE*. Third Alpine Water Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

2.2 Major water management issues

On the basis of the national contributions, the RSA II also identified and provided a clear picture of the major water management problems shared by all Alpine countries and to be tackled in order to guarantee a sustainable and ecologically sound development of the Alpine area and preventing water uses conflicts. They include in particular the needs:

- to provide integrated risk management against natural hazards, as the high costs made each year for this particular field indicate,
- for EU Member States to implement and update river basin management plans according to the time schedule of the EU Water Framework Directive including coordination with non EU countries,
- to find ways and approaches to use hydropower without impairing excessively river ecology and river hydro-morphology, with a particular focus on preserving the remaining rivers and river stretches which are still unspoilt,
- to remedy hydro-morphological impacts of the past due to flood protection measures and hydropower plants and, here in particular, to restore river continuity, to improve lateral connectivity of rivers with their surrounding terrestrial habitats and groundwater bodies; to provide an ecological sound amount of residual water; to reduce the negative effects of hydro- peaking and last but certainly not least
- to adapt to the consequences of climate change in spite of all efforts to mitigate the causes of the on-going change. Modelling results predicts – depending on the contemplated region – that more or less pronounced changes will occur in temperatures and precipitations and thereof resulting impacts on the water balance. Forecasted changes may therefore:
    - increase the risk and impact of natural hazards, including in particular flooding and, where relevant, rock falls due to the warming up of permafrost, and therefore require enhanced efforts for integrated risk management beyond the already high level of efforts,
    - increase periodical problems with droughts and water scarcity in particular in the southern and south-eastern parts of the Alpine range

which may require enhanced efforts in the management of water quantity and paying attention to downstream needs,

- impact water availability due to changing runoff from glaciers and snow-cover,
- impact the already exploited amount of hydropower generation through changes in the water balance as well as efforts to increase hydropower generation in line with the EU targets aiming at: increasing energy efficiency, reducing greenhouse gas emissions and increasing the share of renewable energy each by 20%, thus potentially endangering those river stretches close to natural conditions to reach these objectives,
- have an impact because of increased pressures (like artificial lakes and related skiing infrastructures) due to increased water and energy demand for artificial snow production.

2.3 Overview of the River Basin Management Plans in Alpine Countries

At international level the Water Framework Directive (WFD) of the European Union sets the reference legislative framework for water management and water-use conflicts. The approach of the WFD is based on two key concepts: 1) the foundation of the water management concept at the river basin level; and 2) the concept of the ecological status. The Water Framework Directive requires Member States, through the application of a stepwise procedure, to identify the river basins, set up river basin districts and institute a competent authority. Furthermore, EU Member States should have developed by 2009, for each river basin, a River Basin Management Plan (RBMPs) which outlines the monitoring and control details as well as a number of other measures taken, or to be taken, in order to reach the WFD objectives. RBMPs will be reviewed and updated in 2015 and every six years thereafter. The RBMPs identify problems at different scales and different times and also different approaches in order to reach the “good ecological status”. The concept of “good status” is applied to the “water body” that doesn’t correspond to the individual river but comprises all the various elements such as tributaries which are different for physical

features, underground water and a downstream sector within its area. Figure 2.2 shows the overview of the river districts/basins on European scale.

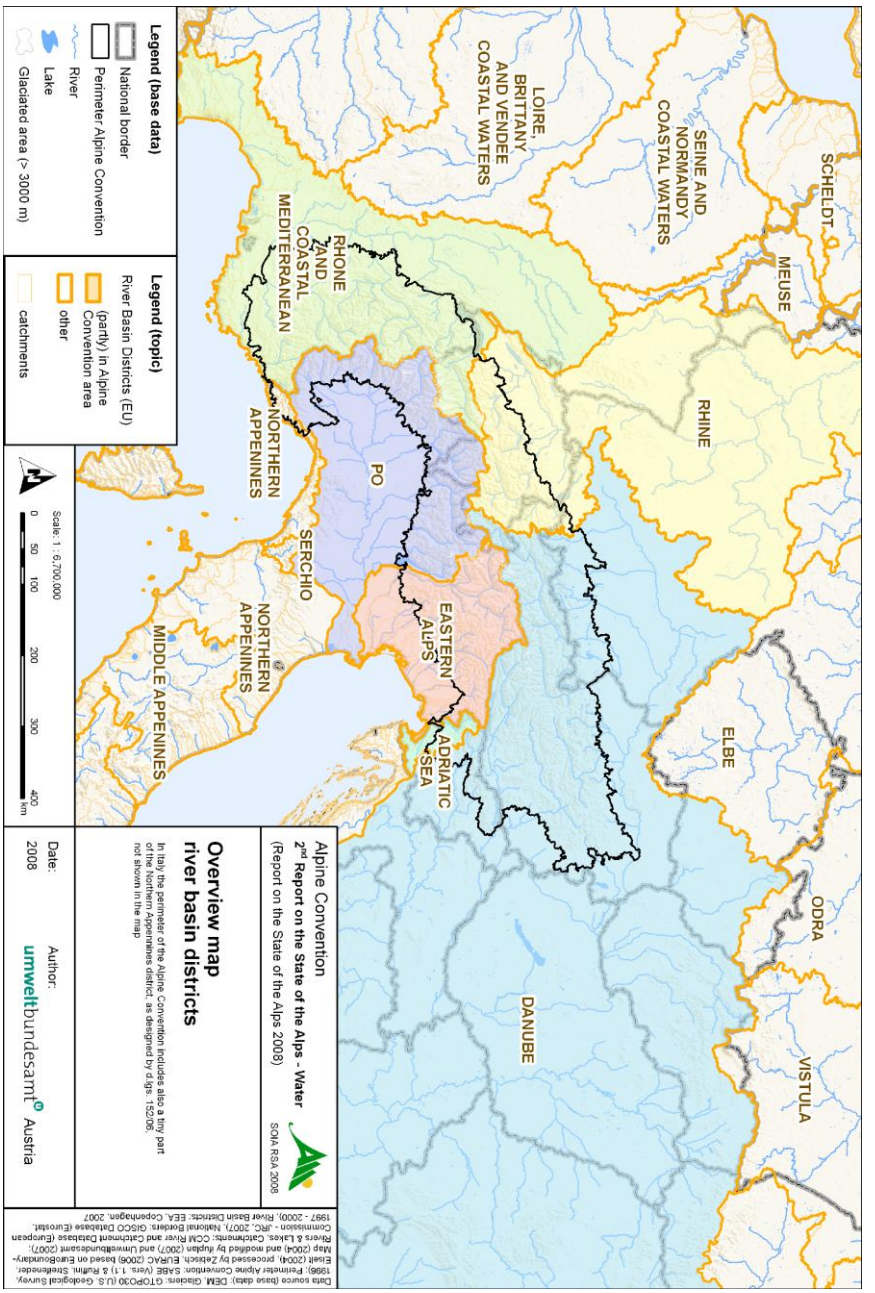


Figure 2.2 - Overview of the river districts on European scale (RSA II 2009)

The national river basin management plans (RBMPs), prescribed by the EU WFD, are currently binding for all state authorities even if legal and formal status is different in the individual Countries, some have ordinances or acts, others binding documents; the transboundary river basins have their own Plans as well which have been developed through multilateral, bilateral or technical arrangements and have been transposed within the respective national Plans.

On the basis of its mandate, the platform of the Alpine Convention on "Water Management in the Alps" reviewed the RBMPs within the reference area of the Alpine perimeter of each country according to the Alpine Convention, in order to highlight whether alpine specific issues were adequately covered[45]. The study is based on a template compiled by 5 of the member states (Austria, France, Germany, Italy and Switzerland[46]) and focused on a list of 7 major water management issues and challenges. Out of these seven, three (climate change, monitoring, hydropower) were highlighted in the RSA II and the last four (ecological status, continuity interruptions/morphology, legal status and other issues such as artificial snow making and water use conflicts) emerged in the Platform's discussions.

In the following part of this chapter are the indications with regard to the RBMPs issues emerged during the study and integrated with those arose during the 3rd International Conference on "Water in the Alps" held in Venice on the 25-26th November 2010 and during its 2nd preparatory workshop held in Torino on October 13th, 2010, named "River Basin Management Plans as an instrument for the safeguard of the alpine mountain ecosystem and forests". During the two meetings beyond the above mentioned aspects important indications emerged with regard to the general structuring of the RBMPs.

[45] Platform Water Management in the Alps of the Alpine Convention (2010a). *Summary and Conclusion of River Basin Management Plan Reviews in Alpine Countries.* Draft on discussion at the Third Alpine Water Conference.

[46] The basis for this review are: for Austria the "Nationaler Gewässerbewirtschaftungsplan", for France it is the SDAGE (Schéma directeur d'aménagement et de gestion des eaux) of the Rhône-Mediterranée basin, for Germany and Italy their regional river basin management plans. As a non-member of the EU, Switzerland is not formally subject to the EU-Water Framework Directive (WFD) and the Swiss water legislation does not include a regulatory framework as it is given by the WFD. Therefore replies from Switzerland were based on general information on Swiss water policy with regard to the raised issues.

Climate change and generic measures

Changes have been observed in almost all Countries within the Alpine perimeter in particular on hydro-meteorological conditions. At this regard, a significant upward trend for temperature has been found which can be identified in quantitative terms. Concerning the influence of climate change on runoff, precipitations and the other hydrological components that are less marked and homogenous, the poor available information allows to proceed only in qualitative estimations. Figure 2.3 shows the extreme deviation of the temperature from its average as recorded from June to August 2003 during the drought event: in some areas the difference exceeds 4°C (UNEP, 2004)[47].

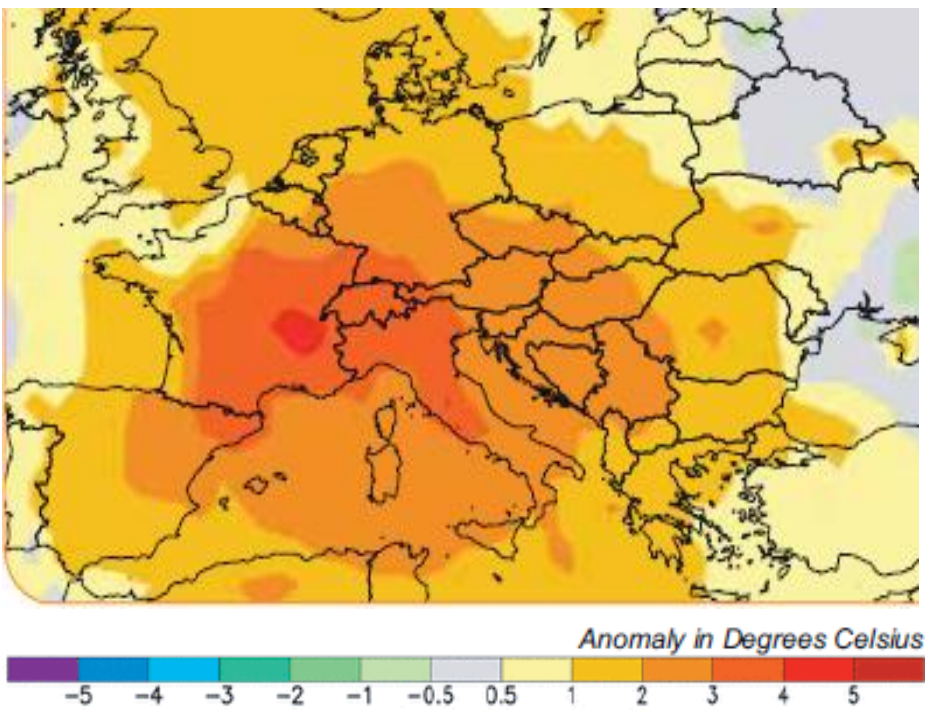


Figure 2.3 - Extreme deviation of the temperature from the average (1988-2003) from June to August 2003 (UNEP, 2004)

According to the review carried out in the framework of the "Water Platform" study[48], more research and more specific studies are considered to be

[47] http://www.grid.unep.ch/product/publication/download/ew_heat_wave.en.pdf
[48] Platform Water Management in the Alps of the Alpine Convention (2010a).

necessary to derive concrete measures and actions to mitigate climate change impacts. At the moment only specific actions in some sector can be enacted and only transversal measures on the different fields are activated to contain the effects of climate change. Though, direct and generalised actions are not yet applicable due to the lack of specific data on the effects of climate change. Therefore, the focus is at present more on "no regret measures" and flexible, adaptable concepts rather than concrete measures. Currently only Italy reported concrete measures (e.g. resource conservation plans, promoting (sound) irrigation management, etc.). Enhanced insight into future changes in the hydro-meteorological parameters and its consequences for water management is deemed necessary to provide solid grounds for more concrete actions in the forthcoming revision of river basin management plans for the period 2015 to 2021. Concrete actions to be included in the next management cycle of the RBMPs are necessary and regard in particular:

- the definition of the residual flows under climate change conditions;
- the enhancement of the preparedness to the changing hydrological conditions through the collection of strategic information on water scarcity and droughts such as the number of the licenses for water uses in place, their typology and characteristics, the rules on reservoirs management. Drought and water scarcity issues require a deeper insight with specific reference to the aspects of the quantitative evaluations and the preparedness for the review of the WFD, that is expected in 2012[49];
- the study of the river basins resilience to the changing hydrological conditions.

Monitoring

Networks for monitoring water quality (figure 2.4, figure 2.5) and quantity (figure 2.6, figure 2.7) are in place all over the Alpine perimeter (see also RSA II); however some countries see to some degree a need for improvements. There are significant differences among the RBMPs and some States, such as Italy and France, consider that a further integration of the monitoring systems

[49] Mysiak, J. (2010). *The conflicts in the uses of water resources: economic and social aspects.* 3rd Alpine Water Conference, Venezia, Italy, 25th-26th November 2010.

is necessary. A structured monitoring activity, in compliance with the WFD requirements, is one of the key actions needed to guide and fine tune useful actions to reach environmental quality objectives. In Italy, the state of quality in the Plans shall be reviewed on the basis of the results of the monitoring activities carried out in compliance with the recent Ministerial Decree DM 56/2009.

A particular challenge addressed in the replies from the different Countries and from different speakers both in 2nd preparatory workshop and in the 3rd Water Conference is the need to improve the coverage with monitoring sites in higher altitudes (>1000 m a.s.l.), currently not well-developed due to limited accessibility and elevated costs. Although it has been acknowledged that pressures and impacts are less in higher altitudes, there are still missing pieces of information on other important issues as the classifications of water of small rivers and in high watershed, flows in time and space and water cycle.

Only few stations test the superficial water quality, but often springs are considered to be a part of the groundwater system that is also investigated in the high altitudes, and thus water quality may be seen to be at least partly depicted by those sites. Otherwise this aspect has to be more investigated in the review process of the RBMPs; some of the States expect that the check on the adequateness of the monitoring systems and a proposal for its integration and optimisation will be an input for the first review of the RBMPs. A focus on the Austrian water quality and quantity monitoring system (figure 2.8), points out a quite high number of sites which are also covering higher altitudes.

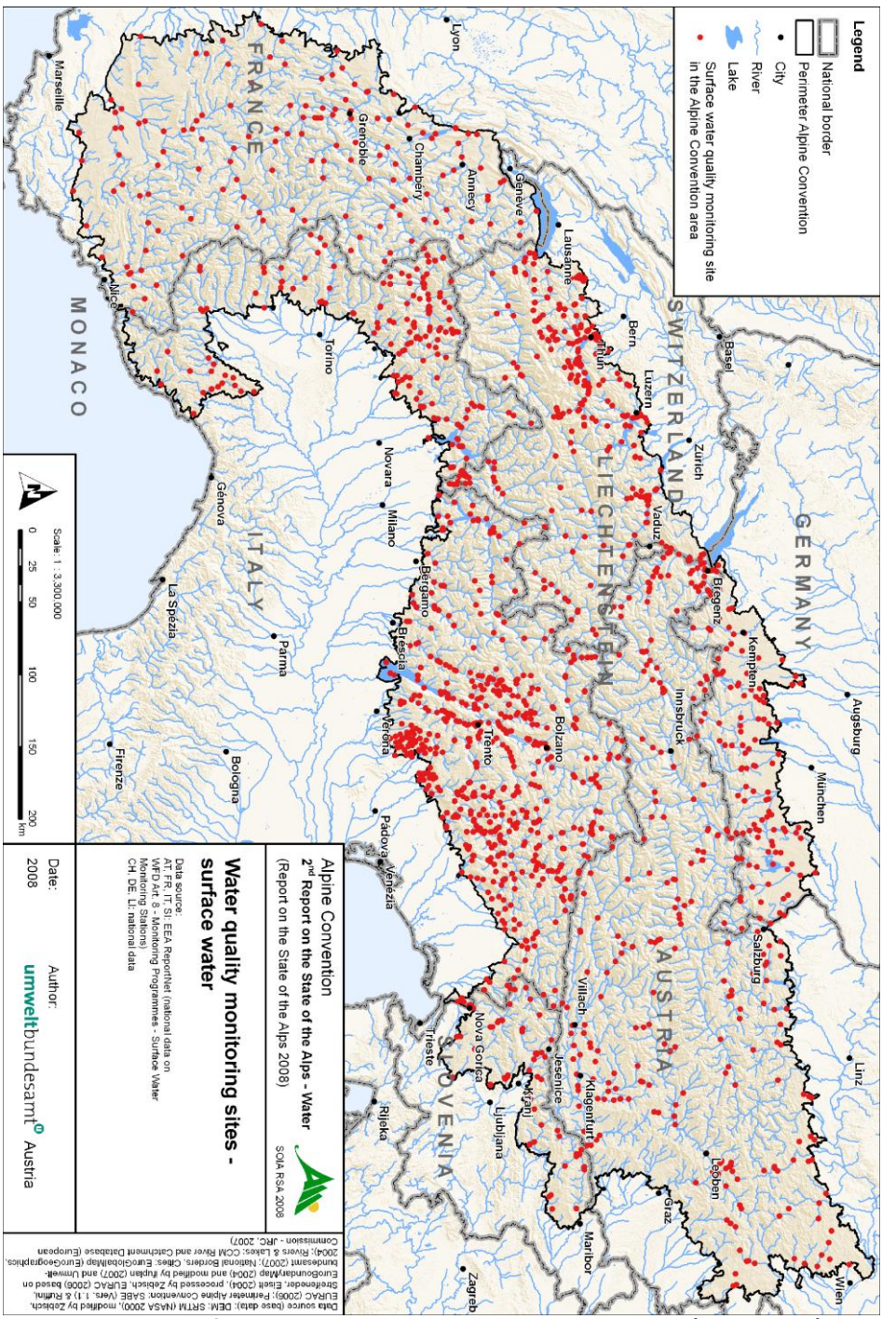


Figure 2.4 - Surface water quality monitoring sites in the Alps (RSA II 2009)

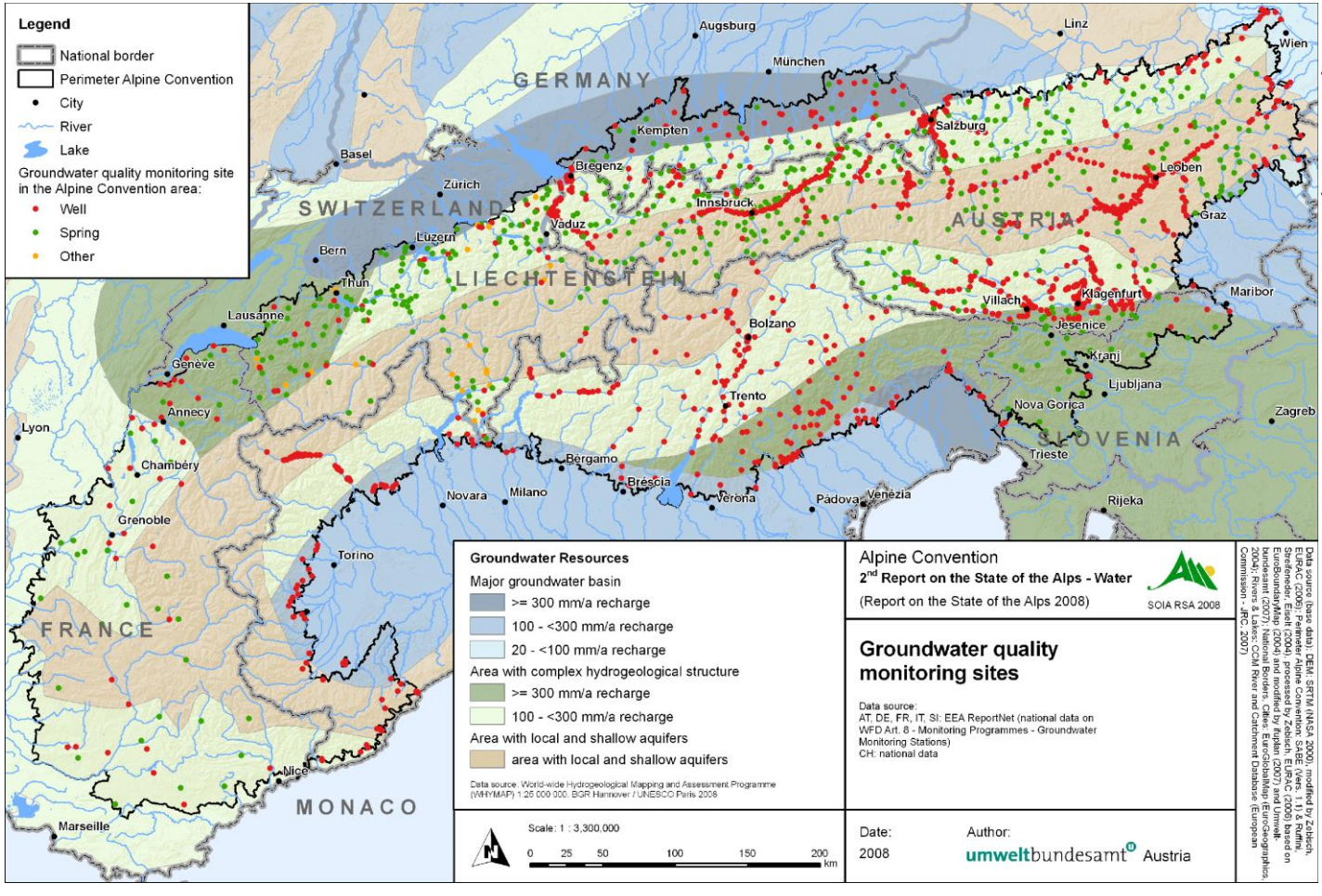


Figure 2.5 - Groundwater quality monitoring sites in the Alps (RSA II 2009)

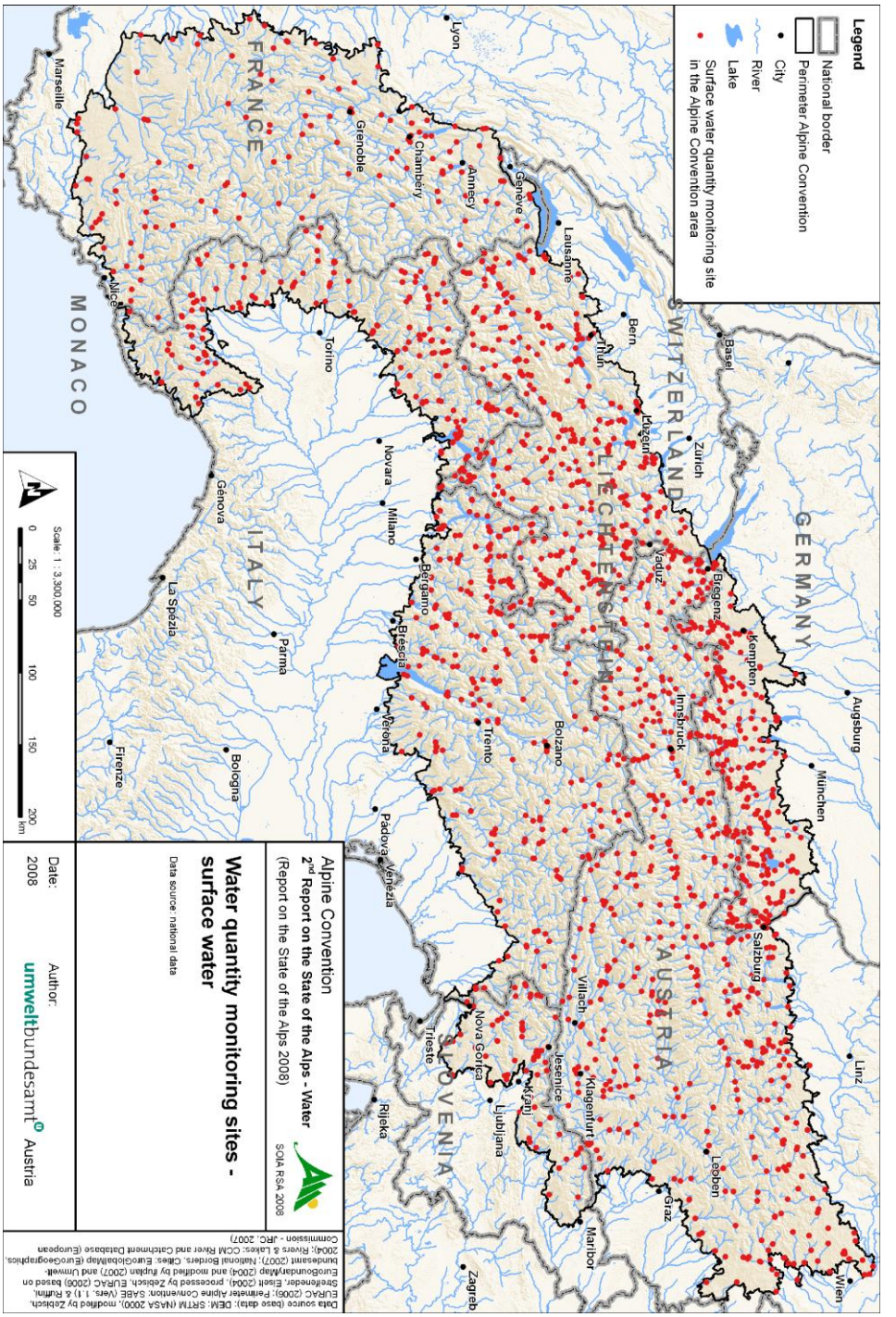


Figure 2.6 - Surface water quantity monitoring sites in the Alps (RSA II 2009)

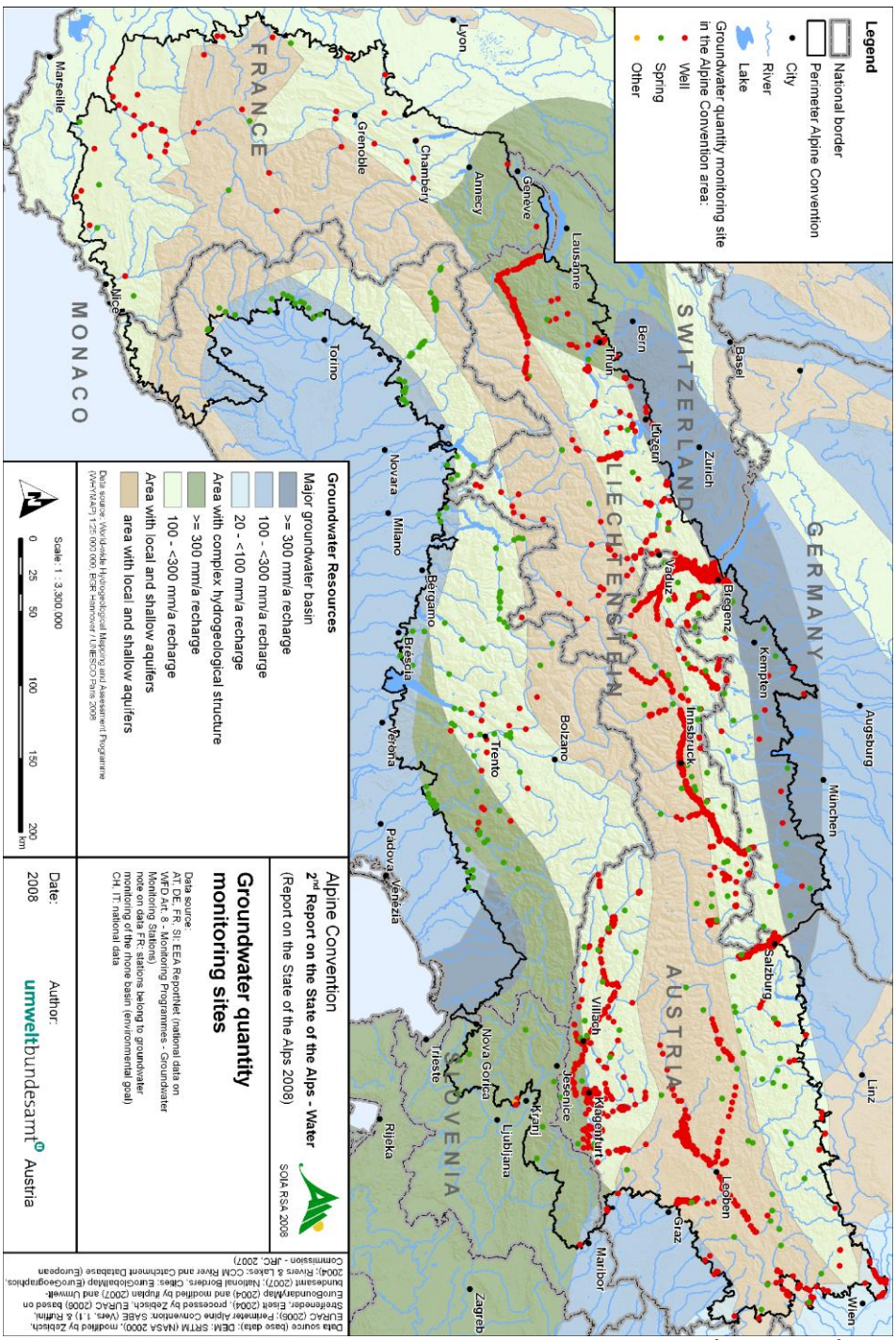


Figure 2.7 - Groundwater quantity monitoring sites in the Alps (RSA II 2009)

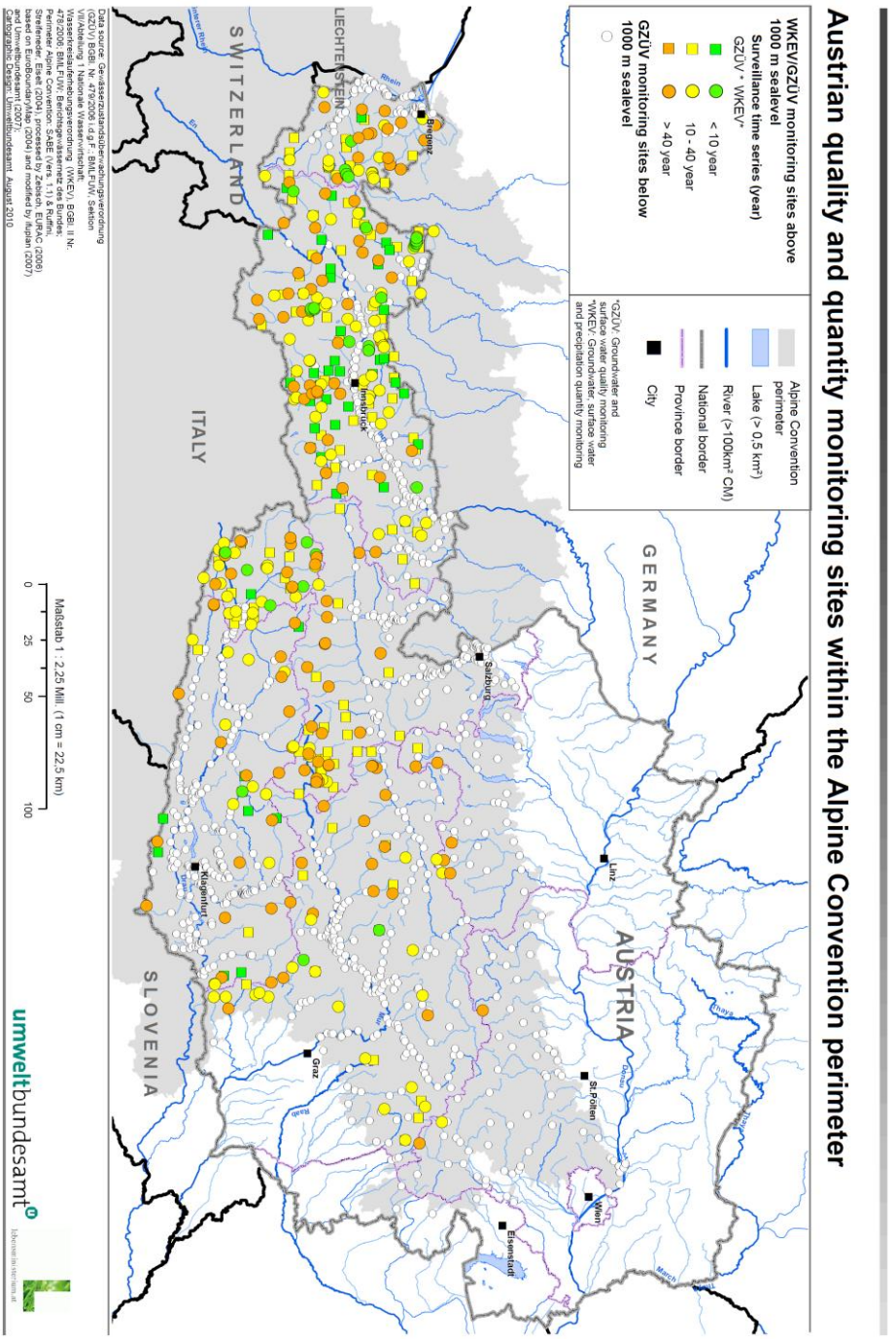


Figure 2.8 - Austrian quality and quantity monitoring sites on high altitudes (Platform Water Management in the Alps 2010a)

Therefore, especially for high altitude areas arose, at European level, the need to strengthen the monitoring network. The integration of the monitoring network is fundamental to better manage the financial planning of the measures forecasted by the single RBMPs and the allocation of funds on the occurrence of specific events. At this purpose, for the future European Regional Development Fund period (2014/2021), it should be desirable to require the inclusion of alpine territories among the areas of particular interest, for which specific supporting processes (involving local communities) and programmes for the safeguard and protection of these territories – which still play a fundamental role as biodiversity and environmental hotspots – should be earmarked.

With reference to the data collection and analysis, statistics on water during the time have reached both a good quality and reliability level, notwithstanding there are still difficulties in finding statistical data, sharing standardized classifications, as well as a lack of adequate measurements. Data and statistical analyses in the environmental field are essential to plan and manage water resources, but it is necessary to use unique indicators in classifications and calculation methodologies, so that these can be compared. In some areas and fields, the level of knowledge is still completely inadequate, such as in the case of consumption of underground water (ISTAT, 2010)[50].

Hydropower[51]

An high number of hydropower plants are in place within the Alpine perimeter and in particular of small hydropower stations (about 3500 Stations <1 MW)[52]. The Alpine area is still attractive for further development of hydroelectric power, given the remaining hydroelectric potential and the current economically favourable conditions. The pressure exerted by hydropower plants is well assessed by all the analysed RBMPs, environmental aspects have

[50] Tersigni, S. (2010). *Drinking water supply and consumption in the Alpine hydrographical districts*, Third Alpine Water Conference, Preparatory Workshop n. 2, Torino, Italy, 13th October 2010.

[51] A much more detailed discussion on hydropower production can be found in Chapter 3 of this book, which is entirely dedicated to the analysis of the hydropower sector in the Alps.

[52] For more details see the *Second Report on the State of the Alps* (RSA II) and the *Situation Report on Small Hydropower Generation in the Alpine Region focusing on Small Hydropower.*

been taken into account with different provisions and measures enshrined in the RBM plans or in national legislations. Some Countries consider in their RBMPs strategic plans for the development of new hydropower, settling new capacities (explicitly addressed by Austria and Switzerland) to enhance the share of energy coming from renewable resources as well as for enhancing environmental parameters of the water bodies. In the other countries these measures have set up to be enacted by the Authorities competent at local scales. All the RBMPs and the national legislations have set up provisions and measures to protect the river basins regarding to the ecological aspects affected by the hydropower production, in particular they all consider a residual downward flow of the exploitation section and the introduction of fish passes is also forwarded. Specific measures to minimize the hydro-peaking impacts are also in place in 4 out of 5 Countries but these measures are mostly aimed to compensate the impacts instead of changing the operational approach, the discharge management. All the Countries endorse some partial financial incentives to restore river continuity and hydro-peaking impacts.

In order to promote a sustainable development of the hydropower, it is necessary to establish a clear guidance on authorization procedures in relation to the WFD. The development of hydropower capacities could be supported first by the modernization and the upgrading of existing infrastructures in order to minimize the need for new sites; second by pre-planning mechanisms, in which regions and municipalities allocate suitable and "non-go" areas for the development of hydropower (Pineschi, 2010)[53].

Ecological status of alpine water

One of the expected outputs of the RBMPs was the survey conducted on the ecological status of the river basins. A focus on the ecological status/potential of the Austrian surface water stretches is shown in figure 2.9.

[53] Pineschi, G. (2010). *Comparison of the legal framework: from European to local level.* 3rd Alpine Water Conference, Venezia, Italy, 25th-26th November 2010.

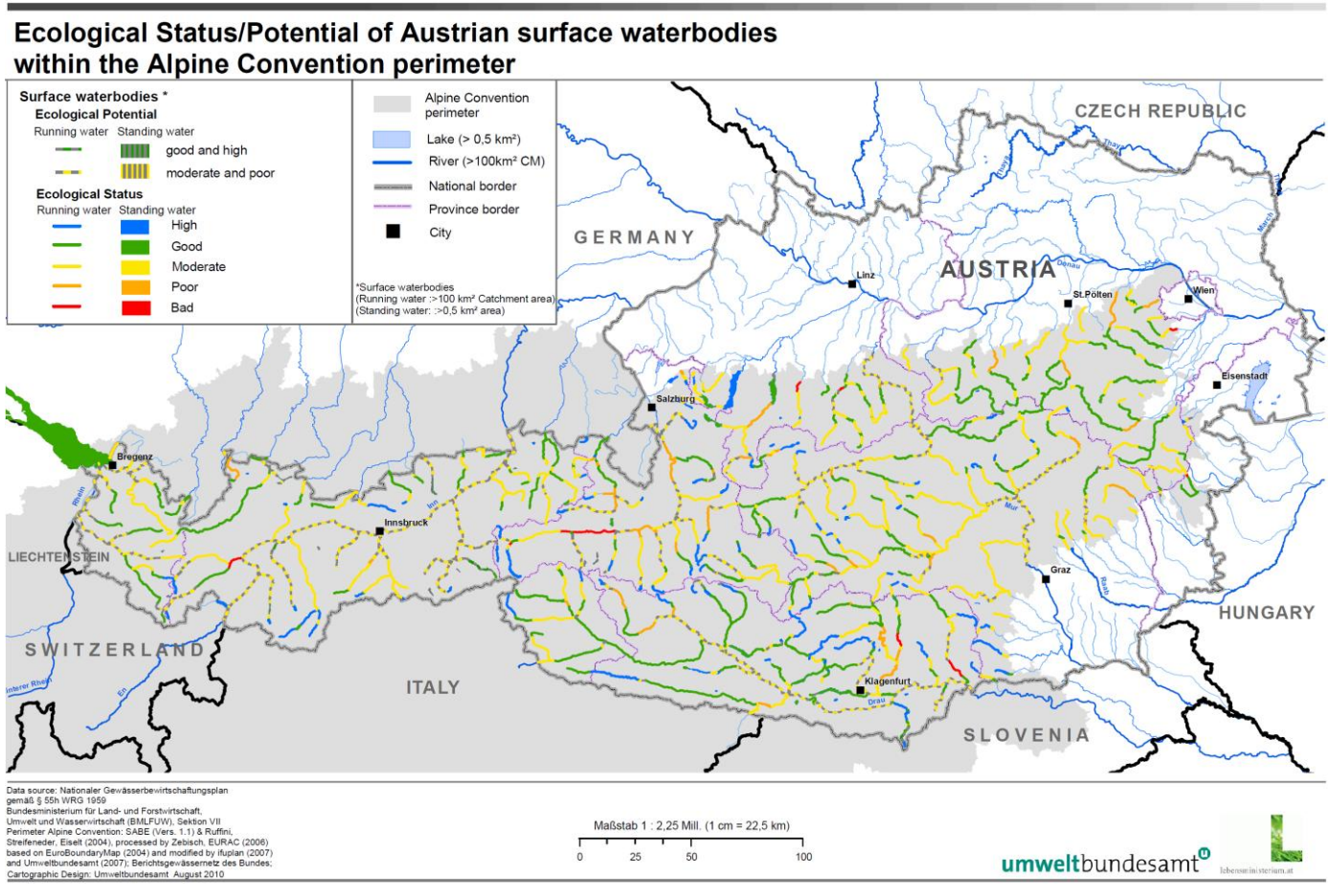


Figure 2.9 - Ecological status/potential of the Austrian surface water stretches. (Platform Water Management in the Alps 2010a)

Within the Alpine Convention area the status of water seems to be better than outside but there is a significant difference between the southern and the northern part where the share of water bodies classified as "not in good ecological status" seems to be higher, but globally the number of heavily modified water bodies is not relevant with respect to the total number of water bodies (table 2.1) (Platform Water Management in the Alps, 2010a). The main impacts on the ecological status of the water are depending on the flood protection and the hydropower (Platform Water Management in the Alps, 2010a).

Table 2.1 - Water quality status of the Alpine river stretches in some Alpine countries (Platform Water Management in the Alps 2010a)

Country	River lenght [km or water bodies]	High status [%]	Good status [%]	Worse than good status [%]	Heavy Modified Water Bodies [%] rivers
Austria	19.094 km	22	24	54	9.9
France	12.500 km	12	59	29	20
Germany	150 water bodies	1	57	42	13

Despite several attempts and the achievement of some outcomes, a proper classification of river stretches is not actually available, due to the lack of an appropriate and shared classification method, especially for the alpine rivers. As an example, the used indexes for *phitobentos* and *macrophyta* are trophic indexes[54] that don't focus on the quality of communities but instead on the trophic status where the communities live. This does not mean that communities don't change due to the effect of the different impacts but rather that the used indexes do not represent the correspondent effect. Moreover, the *macrozoobenthos* and the aquatic fauna indexes don't measure the absolute abundance of the populations. For the reasons above mentioned, further research on these aspects are expected and should be aimed in

[54] Trophic indexes are used to evaluate the quality and the environmental state of the specific water body through the calculation and combining of the presence and the concentration of different substances (Source: http://www.apat.gov.it/site/it-IT/APAT/Pubblicazioni/metodi_bio_acque.html)

particular to the definition of more suitable indexes.

The evaluation of situations linked to the use of the resource rather than to the quality aspects may have the consequence to be not able to properly highlight the effects on the population (in the mentioned case the reduction on the numerousness of the *macrozoobenthos* and the aquatic fauna populations) (Rocco, 2010[55]; Goltara, 2010).

Another important aspect to deepen refers to the definition of "reference conditions", in particular for the alpine rivers. For example rectified rivers, completely defended by lateral river banks are often considered as "natural" and this is questionable. A strong discussion on the "reference conditions" and on the inclusion of the hydro morphological aspects on their definition is desirable (Goltara, 2010).

Continuity interruptions and morphology

Hydromorphology is one of the main issues in the whole Alpine area; impacts on hydromorphology are the ones that mostly affect the objective of reaching the "good ecological status" of the water bodies by 2015.

Moreover, the biological indexes that the WFD asks to use, are slightly sensitive to the hydro morphological aspects and thus give some optimistic results especially in the Alpine rivers, where the water quality is quite always good but the hydro morphological aspects are prevailing (Goltara, 2010; Rocco, 2010).

The study led by the Platform highlighted that all the Countries have schemes in place to prioritise actions and measures aimed at reaching the "good ecological status" of the water bodies. Four out of five countries have reported financial support schemes to be in place to fuel concrete remediation measures, thus contributing to achieve "good ecological status" while the last Country reported still on-going developments at national and regional level otherwise but, due to the considerable number of water bodies affected, only a share of water bodies/river stretches will be remediated for good ecological potential by 2015.

[55] Rocco, R. (2010) *The evaluation of the environmental and social impacts of the hydroelectricity withdrawals: criticalities and perspectives in Valle d'Aosta.* Third Alpine Water Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

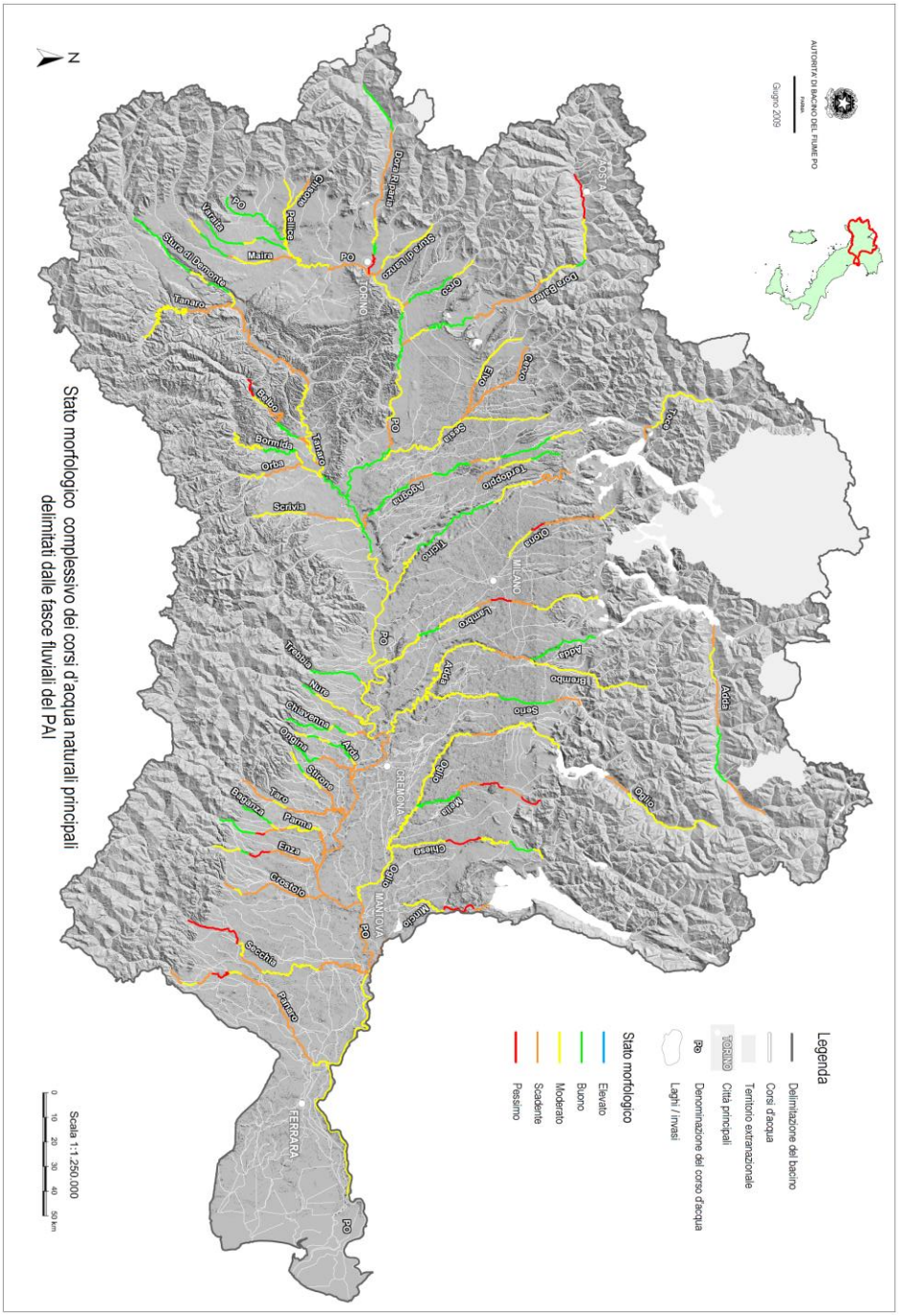


Figure 2.10 - Classification of the main Po river basin stretches on the basis of the hydro morphological aspects: map (Puma, F. 2010)

Stato tratti morfologici	n°
elevato	0
buono	66
moderato	129
scadente	96
pessimo	17
totale	**308**

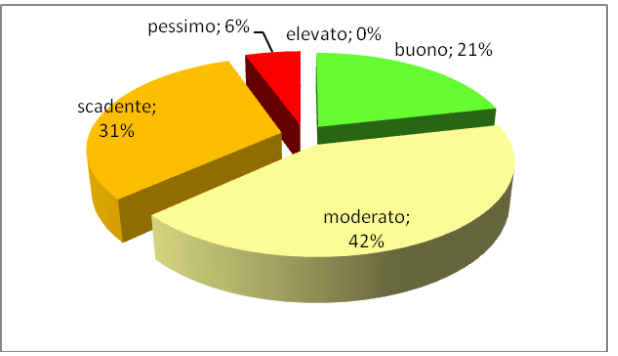


Table 2.2 - Classification of the main Po river basin stretches on the basis of the hydro morphological aspects (Puma, F. 2010)

Po River Basin Authority has a good knowledge on the hydro morphological aspects; if looking at figure 2.10 and table 2.2 is quite clear that hydro morphological aspects seriously affect the ecological quality status of the rivers.

With regard to the hydromorphological issues it is expected and forecasted that additional measures have to be implemented in the 2nd and 3rd cycle of the RBMP (Platform Water Management in the Alps, 2010a).

More knowledge is desirable also with regard to the hydro morphological aspects for the high altitude small rivers that, due to their simplified hydrologic structure, are less resilient and so can be affected seriously (e.g. the effect of new concessions on small rivers) by impacts and pressures of smaller entity.

Artificial snowmaking

Artificial snowmaking has been addressed by just one country (Italy) as a relevant issue, whereas for four countries this is not deemed a relevant water management issue at regional and national level. From the point of view of the regional and Alpine-wide water resource balance, the total estimated amount of water used for snowmaking in the entire Alpine region correspond to only 1,5 – 4% of Swiss water consumption. Notwithstanding, water requirements for snowmaking can be substantial at a local level, using a considerable share of the annual water abstraction and can lead to water conflicts especially in the winter season in areas where snowmaking stations are connected to the drinking supply network; this can cause temporary water shortages. Moreover,

artificial snow production can also have significant ecological impacts on vegetation, soil, animals and aquatic ecosystems. Impacts differ largely between regions, elevation etc. (RSA II, 2009). More knowledge on regards of the impacts of the snowmaking on the environment is desirable.

Conflicts for water use

The use of water, although it is abundant in the alps, can lead to conflicts. The analysis of the rather patchy available information has been reported some conflicts among different water users and in particular with regard to the hydropower that was mentioned explicitly (for this aspect see chapter 3). A positive approach for the solution of the conflict is the stipulation of water agreements, there is indeed an empirical evidence that the stipulation of water agreements which have been concluded over the past centuries triggered positive social changes (Mysiak, 2010). A positive approach for the individuation of solution, which is aimed at a better understanding of the problems from the physical point of view is the development of research projects. On this respect a good example is represented by the CH2OICE project (Conte, 2010). From the results of the project, it emerges that the conflict with the hydropower production exerts pressures not only on the residual flows but also on other aspects, such as the physical alteration of the river bed, the river flow regime, the bed load transport and others that have to be considered separately in the RBMPs.

Discussions concerning the role of water in the next future, focusing on the arising conflicts for the possession and the use of this resource, also in the light of climate change, have been set up and are expected to give some important results to assure a proper revision of the RBMPs.

On the actual implementation of the River Basin Management Plans

The Management Plans for hydrographic basins have to be implemented with a clear and realistic approach – which may sometimes require bold choices – limiting the use of derogations as much as possible. For this purpose, it is necessary to establish - on the basis of economic analysis (which still has to be adequately developed in the Plans) - that the costs for the implementation of the plans shall be carried by the users of water resources (tariff or fee),

according to the "polluter pays" principle. Some problems emerged also with regard to the suggested approach for the three different levels of the RBMP: policy, planning and programming, project. Moreover, the discussion between the Authorities, the stakeholders and the NGOs has provided some important indications on the general expectation on the regard of the RBMPs (Puma, 2010; Pineschi, 2010). The next paragraphs analyse the three different levels above mentioned.

It is expected that the water protection policies seek an integration between different policies such as agriculture and energy production. In particular, a special attention has to be posed the transparency in decision making (e.g. through cost-benefit analysis). It has been recognized that the first version of the RBMPs only partially envisages the necessary dialogue with other policy elements, such as the Flood Directive (2007/60/EC), the Directive 2009/28/EC on the promotion of the use of energy from renewable sources and the new negotiation phase of the CAP (Community Agricultural Policy) (Pineschi, 2010). Further dialogue and harmonization of the different legal regulations on the matter would help properly cope with central issues for the Alpine environment such as the not deterioration of the environment and the impact of climate change.

Moreover, regional and local adaptation strategies, considering all sectors and dealing with transboundary or trans basin issues are needed (Isoard, 2010).

A deeper integration of these aspects is expected to be included in the next review of the WFD foreseen for 2012.

The RBMPs should become a milestone at planning and programming level, able to connect the existing plans at the proper scale and promote the coordination between different sectorial plans and different goals. It is then expected that the RBMPs properly individuate the causes of the deterioration of the river basins and recognize the possible conflicts on the goals of the WFD. In this direction goes the promising flood-risk management approach of freeing space for rivers that needs to be supported by land-use planning policies and can be combined with agricultural and forestry activities in order to establish a multi-criteria approach (Terzuolo, 2010). For the Alpine area, the specific causes of and actions to cope with river deterioration have been only partially identified and should be better investigated. Some of the issues that would

require more attention include:
1) the artificialisation of the Alpine rivers, due to its consequences for the hydrological risk and river bed mobility,
2) the conflict with the use for irrigation (often over estimated) and with fish farming,
3) the conflict with tourism and artificial snow making that has become a central issue,
4) the conflict with hydropower production.

Regarding the goals it seems not to be enough defining separate objectives at the district scale and for both the single river and the single basin. This approach doesn't take into account the basin complexity, it is thus necessary to use a wider territorial approach and better investigate the existing relationship between different rivers and different basin insisting on the same area. At this regard, at least two levels have to be taken into account: goals have to be defined also with regard 1) to the single basin and 2) the influenced downward basin. Moreover the study on the role of the single sub-basin with respect whole basin general goals (continuity for fish, bed load transport, release of new concessions, groundwater recharge, flood lamination) would be desirable. On the basis of the results of the mentioned studies more specific measures could be defined to recover or maintain the quality status of the rivers. The mitigation actions or measures individuated at the planning level have to be planned by implementing the WFD Art. 4: "assessment of the impacts and the needed mitigation measures" have to be punctually declined to the design and final implementation level. Finally, beside applying the WFD measures, it is also important to set up a proper control system to verify the their effective application and their adequacy.

In the implementation process at the policy, planning and project levels, the Common Implementation Strategy (CIS) for the Water Framework Directive recommends the maximization of the dialogue and co-operation between the different competent authorities and organizations, experts and stakeholders in order to plan the protection of water bodies and contribute to a better integrate the hydromorphological aspects in the policy. This integration should take place with regard to the three stages of *prevention, restoration and*

mitigation that are foreseen by the WFD (CIS, 2006[56]). In some cases, such as in Italy, notwithstanding wide communication, consultation and information initiatives (including institutional web sites, meetings involving the public aimed to collect comments through questionnaires, e-mails, contacts and dedicated events) there was not yet any real feedbacks on the plans (Pineschi, 2010). Instead, the participation of the stakeholders at the local and regional level, according to the overall philosophy underlying the WFD, is considered very important to make them aware of climate change because of the social consequences that derive from the implementation of the foreseen measures. Providing incentives and financial support, measures of promotion of the directive's goals, being able to raise the stakeholders' awareness, as well as technological measures are also fundamental for the success of any adaptation strategy (Isoard, 2010).

When RBMPs are to be reviewed, an intense participation of the public is desirable. A plan behaves as a sort of multifaceted fractal, where the great complexity of the river basin is taken wholly into account and the participation should be ensured at all levels. In order to achieve these higher levels of participation a twofold approach might be used to collect vital information:

- at the lower level (micro), some extensive participatory tools exist (e.g. the River Contracts and the Agenda 21 projects), that allow local actors to provide detailed information that, otherwise, it wouldn't be possible to gather, and which can help reduce possible conflicts in water use;
- at the higher level of the RBMPs (macro), where policy development, planning and programming choices are to be made and different component need to be harmonized through coordination, participation procedures are enacted to receive comments and improve the quality of planning (Pineschi, 2010).

Ad hoc negotiation instruments have been imagined to deal with the substantial complexity of the integral approach to river basin planning.

[56] CIS (2006). *Common Implementation Strategy for the Water Framework Directive - WFD and Hydro-morphological pressures*, Policy Paper – 3. November 2006.

Economic analysis

According to the WFD, the RBMPs have to include some substantial economic considerations, and require a sound analysis in terms of costs and benefits they generate. More in detail, the price of water services should cover all the costs incurred in by the provider, including the environmental and resource ones. Water pricing policies should then aim at incentivising water users towards an efficient utilization of water resources (WFD, article 9). More, when different water uses are to be considered, each having its own value, a cost-effective combination of measures addressing the possible alternative options has to be searched for (WFD, Annex III and article 11). Also, in some special cases, an economic justification can be provided for derogation from compelling provisions – e.g. when the achievement of the environmental objectives is disproportionately expensive; or the benefits of a modification to, or a completely new economic activity outweigh the benefits deriving from the conservation of a "good" water status (WFD, article 4).

From a first analysis, the RBMPs generally fail to fully incorporate the economic principles recalled by the WFD. The costs of resources have not been factored in most cases. Their exclusion from the "full cost recovery" principle seems to be due to some difficulties from the member states to practically translate them into water management tools (Mysiak, 2010). Though, these aspect should be better studied in order to really support decision making from public administrations and politicians. The economic analysis could be really effective only if able to catch all the structural/economic alternatives on the arrangement of the river basins, including the evaluation of the sustainability of the complete removal of the pressure that generated the impact.

At the theoretical level, the cost of water has not to be assessed only as the cost of the resource. Instead, it has to be related to its use and the generated impact (e.g. on the environment, if any). Moreover, since water has different uses and satisfies different needs, an "purely economic" criterion to evaluate water uses cannot be applied. It has to be accompanied by an equity criterion, that implies looking also at the distribution of benefits and costs across the society, and the present and future generations, as stated by the Sixty-fourth UN General Assembly on the 28 July 2010 resolution: "access to clean water and sanitation is a fundamental human right" (Mysiak, 2010).

2.4 The Alps facing the challenge of changing water resources

A full implementation of the WFD and namely of its provisions on RBMPs is still far to be achieved in the Alpine countries, though substantial steps forward have been made, especially with regard to the planning phase. In this context, the Alpine Convention is expected to play a pivotal role in triggering the directive's implementation process – by acting as a platform facilitating stakeholders' dialogue, promoting the involvement of local and national authorities and public administrations, and helping establish an open confrontation with EU actors and bodies, when appropriate.

In particular, the wide experience gathered by the Alpine Countries and regions, has been regularly discussed and checked under the auspices of the Alpine Convention, with the support of institutional bodies, experts, database (such as the SOIA) and thematic publications (such as the Report on the State of the Alps, RSA). Similarly, valuable information concerning the problems and challenges faced when concretely implementing provisions and principles included in EU legislation has been collected in the framework of other regional cooperation initiatives, including e.g. the thematic territorial cooperation projects financed under the EU Alpine Space Programme. These occasions allowed to collect a critical knowledge-base on distinctive territorial issues that need to be addressed when new policies have to be implemented on the Alpine territory. Such a remarkable amount of fresh and application-oriented knowledge can be seen as a precious asset provided by the commitment of the Alpine countries and the Permanent Secretariat of the Alpine Convention in a wide set of regional cooperation initiatives. The innovative approach to water management intrinsic in the WFD results in a set of specific policies and measures to be assessed, fine-tuned and finally applied in the fragile Alpine environment and its peculiar approach to water resources' management.

An overview of the state of application of the RBMPs as foreseen by the WFD reveals that the plans are in place in all Alpine EU Countries; Switzerland does not have an obligation to establish such plans, but cooperates in international river basins.

Main concerns about the plans' application on the Alpine territory by 2015

concentrate on a rather precise list of topics, that are summarised below:

- Hydropower generation and its impacts are addressed extensively in all river basin management plans in all Alpine EU countries and in Switzerland. In particular, provisions seem to be in place in all countries to ensure an appropriate residual flow as well as river continuity (via fish passes) for new installations. Open challenges for Alpine hydropower sector remain: (1) the remediation for old installations in place, where efforts of upgrading these installations in order to meet modern ecological standards as well as to enhance efficiency will go beyond 2015; (2) the management of hydro-peaking, where current efforts seem to be focused more on the remediation of impacts through structural measures (retention basins), than on changes in the mode of operation. This seems to be due to the overriding importance of storage and pump-storage schemes to meet peak demands and to stabilize distribution grids.
- Water and environmental quality are central issues: only a share of water bodies currently showing “not good status / not good potential” are expected to be remediated by 2015. Thus, collecting further information on the shortcomings and major obstacles to the ongoing remedy policies would help select suitable measures for timeliness and reach. In the Alpine area a more extensive implementation of indicators of environmental quality together with hydromorphological ones, as described in the WFD, is central for a proper application of the river basins planning and management.
- Developing an extensive monitoring on the implementation of the RBMPs by 2015 in terms of both timing and depth is likely to reveal the major open challenges for the Alpine territory on the matter. Including the outcomes of such an analysis in a separate chapter of the forthcoming RBMPs is likely to be a welcome practice.
- Gaps in research, whose outcomes are likely to ease the planning procedures at the river basin level, can be reduced including the following actions: (1) implementing monitoring for waters and water bodies situated at higher altitudes; (2) using unitary data-sets, overcoming difficulties in finding data, for statistics regarding the use of

water and in particular concerning the supply and consumption of drinking water, and sharing standardized statistical classifications; (3) widening and improving the reliability of knowledge on climate change to derive concrete action, in particular by enhancing insight into the forthcoming impacts and the methods to more precisely define residual flows; (4) identifying appropriate methods to actively manage riparian vegetation and undertake continuous maintenance.

- Addressing distinctive problems of the Alpine area with dedicated financial resources and earmarked programmes supporting the safeguard and protection of these territories, by requiring the inclusion of the Alpine mountain territories in the "areas of particular interest" at EU level. The financial resources that could be collected by following such an approach may be addressed to the main challenges of the Alpine territory (partially identified in this list).
- Search for possible synergies among different EU thematic policies and directives having a relevance for the water management sector, including the WFD, the "Flood" directive (2007/60/EC), the outcomes of the negotiations for the new Community Agricultural Policy (CAP), the soon-to-be-born strategic plans for the release of new concessions[57].
- Full integration of RBMPs in territorial planning and programming as currently applied in European Countries and namely in the Alps as planning instruments able to connect the existing plans at the proper scale, and promote the coordination between different sectorial plans and goals.
- Implementation of a geographical approach to water basin management it can be achieved by setting up separate goals in the domains addressed by the WFD for each river basin (and/or sub-basin), according to a territorial approach, and better investigating, e.g.: (1) the existing relationships between different rivers and (2) different basins, (3) the role of a single sub-basin with respect to the whole basin.

[57] Further information on the "strategic plans" is to be found in Chapter 3.

- Recognition of the economic dimension of river basin planning: management by developing an economic analysis of the measures envisaged in the plan and ensuring to cover the costs of the implementation of RMBPs with concrete methods to implement the "User Pays Principle" (UPP) and "Polluter Pays Principle" (PPP) could be desirable.
- Possible establishment of a "clearing house" mechanism through which questions and priorities on water management in the Alps can be discussed with different actors, on the basis of a sound and direct knowledge of the interested territory.
- Identification of the main causes of the deterioration of river basin and recognition of the conflicts that may arise on the goals set by the WFD. A particular attention should be paid to the issue of sediment transport in those river catchments where reservoirs and dams are in place.
- Enhancement of stakeholders' participation processes in the planning activity with special reference to the institutions and the scientific community.

2.4.1 The integrated approach in water management

The issues of water availability and management are central with a view to the sustainable development of the Alpine region. Furthermore, also the surrounding and lowland areas depend on the water from the Alps for their comprehensive development. Sophisticated systems of water management have been developed over many hundreds of years in the different Alpine regions, but now this territory faces new challenges due both to the increasing use of water and to the occurrence of climate change. In particular, due to the growing demand of water, conflicts of interests tend to arise in relation to the use of this resource in the Alps – where the relative abundance in the past contributed to minimize the contrasts. The current system of water management therefore needs to be duly and continuously adjusted to the prevailing "surrounding" conditions (RSA II, 2009).

Currently, some telling experiences in the field of integrated water management at a river and basin scale are to be found throughout the Alps. A

few of them have been gathered and are briefly presented in the following section, they regard in particular the "River and Lake Contracts" that are designed to help promote an "harmonious" implementation of plans and programs covering a very wide range of interlinked issues. From this perspective, Contracts can be a very effective tool for the implementation of the Management Plans foreseen by the WFD and become a common and successful practice as proved by the extensive, long run experience of France with River and Lake Contracts. River Contracts help achieve the environmental quality objectives for water streams through practices of public involvement and widespread participation (of both public and private subjects). They do not create further formal procedural constraints and – while respecting the competences and commitments of all the parties involved – allow investments in the basin area more effective by integrating and steering the available economic resources and plans within a certain territory (Bigué, 2010; Puma, 2010; Pineschi, 2010).

The river contracts ("*Contrats de rivière*") experience in France [58]

The French approach to the integrated water management based on the "Contrats de rivière" or River Contracts is a very promising long-lasting solution for the basins restoration, consistent with the needed implementation of the RBMPs.

In France, since the issuing of the Law n° 64-1245 in 1964 on the organization of water management, the hydrologic basin constitutes the basis and logical foundation of the whole water policy (figure 2.11). In order to safeguard and protect the water resources at the basin level, in each large river basin an advisory body (Basin Committee) and an executive public agency (the Water Agency) have been set up. For each Basin Committee, action plans are developed on a two-scale level: the SDAGE (Schémas Directeurs d'Aménagement et de Gestion des Eaux) at the basin level, and the SAGE (Water Development and Management Scheme) at the sub basin level, both defining the principles for water management over a 15 years period.

In particular, the SDAGE is a formal planning document: it provides

[58] Bigué, J. (2010). *The Rhône-Méditerranée et Corse (France) River Basin Management Plan*. Third Alpine Water Conference, Preparatory Workshop n. 2, Torino, Italy, 13th October 2010.

recommendations and orientations for water management and it is legally binding for public policies. All administrative decision concerning water management must be in line or be made compatible with the SDAGE. Grants are assigned by Water Agencies to public local authorities and private actors, including the industrialists and farmers who intend to save resources, and preserve water quality. The municipalities included inside the territory of a large basin pool together creating a single inter-municipal structure that can answer to European principles of integrated management of the water resource. With this aim, SDAGE at local scale is represented by the SAGE, that is a planning document having both administrative and legal status. Thus, SAGE is binding not only for the involved public administrations, but also for private individuals. Once the SAGE is approved, the decisions made with respect to water by the administrative authorities in the interested sub-basin area must be in line, or made compatible with the SAGE – as it happens for the SDAGE at a higher level.

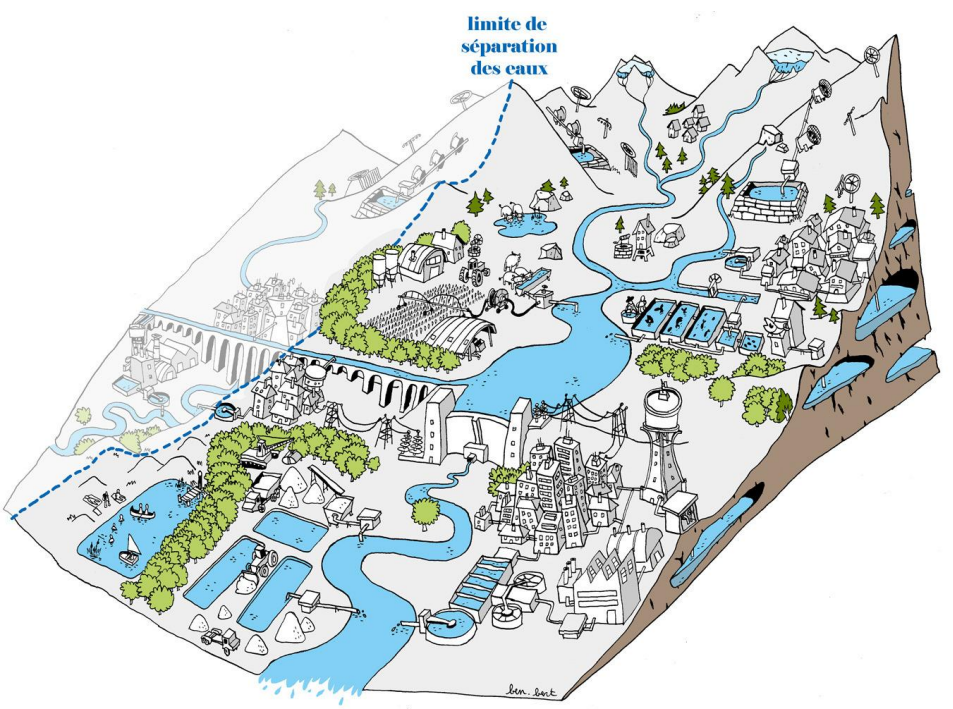


Figure 2.11 - River basin and the main hydrological aspects evaluated in the River Contracts (Bigué, J. 2010)

In application of the WFD's terminology, the large French river basins have become “districts” and the former SDAGEs were further integrated with the environmental objective of achieving a “good status” of water, to transform them into the River Basin Management Plans introduced by the WFD into the EU legal system.

An extensive system of public subsidies and payments aims at fostering the application of the necessary actions: Water Agencies collect fees from water users, calculated according to the "Polluter Pays Principle", on the basis of the quantities of polluting discharge, the volumes of the water withdrawn or returned, and the intensity of the impact on the environment. Contractual tools have been set up also to plan and finance actions that may concern a river, an aquifer or a bay, and are thus called “river contracts”, “aquifer contracts” or “bay contracts”.

In France, the River Contracts are instruments of intervention at a basin scale. They occupy a subsidiary position with respect to the SAGE. They exist since 1981 and are aimed at defining and adopting a detailed program of multi thematic actions over 5 years (which may include the development of construction works or necessary studies, require the name of project owners and responsible persons, clarify the mode of financing, terms of the works, etc.) in order to achieve water quality objectives, assess the aquatic environment and ensure a well-balanced management of the water resources.

A river contract looks after and seeks answers to a set of important questions for a proper management of a water basin. Typical challenges addressed by this instrument include (1) the cost effective use of the resource, (2) the fight to pollution within a basin area, (3) the protection of the aquatic circles, (4) the protection of people and goods against the floods, and (5) the awareness raising of the public in the field of environmental protection.

Thus, a river contract can be seen as an integral project for a river, covering all the river and its watershed and all the related environmental aspects. By involving all the actors participating in the water management process, a river contract tries to take note of all the relevant problems faced by a watershed, an aquifer and their surrounding territories and tries to bring an effective solution for each of them.

More in detail, the River Committee is in charge for both the elaboration and

the adoption of the River Contract and to properly take into account all the interests of all the stakeholders of the relevant geographical territory. The "contracts" are signed between the concerned partners: prefect(s) of department(s), Water Agency and local authorities (General Council, Regional Council, municipalities, associations of communes).

Under an economic point of view, river contracts play a substantial role in steering significant financial investment both from public and private subjects, at the same time making them more effective by allowing the integration of both public and private resources mobilized over the riparian territory and by steering the expenditure and destination of the available funds consistently with the local spatial planning tools (in particular the basin and sub basin plans).

Differently than the SAGE, the contents of a river contract are not legally binding, but they establish a contractual commitment between the signatories.

The River Contract in Europe and Italy[59]

River or Lake Contracts are to be found rather widely in EU, in recent times. They have been developed taking note of the positive lasting experiences implemented in some areas, such as the French case with the "*Contrat de Rivière*".

The River or Lake Contracts are a useful tool for negotiated planning; they promote a "harmonious" implementation of plans and programmes covering very wide ranging issues. From this perspective, Contracts could become an effective tool for the implementation of RBMPs throughout Europe, similarly to the French experience, where they have now become a common practice. River Contracts help achieve the environmental quality objectives of water streams by promoting advanced forms of involvement and widespread participation of the society (including both public and private subjects). They do not add up further procedural constraints and – while respecting the respective competences and commitments of all parties involved – make investments more effective by integrating and guiding the economic resources and plans of a territory, as already anticipated.

[59] Porro, E. (2010). *The "River Contract" as instrument of integration and participation*. Third Alpine Water Conference, Preparatory Workshop n. 2, Torino, Italy, 13th October 2010.

River Contracts are tools of negotiated planning, deeply inter linked to the processes of strategic planning and to the restoration of the river basins both in terms of both damaged landscapes and environmental aspects. Contracts are based on the “co-planning”, a process which is deeply and actively involving a large number of stakeholders and which comprises a substantial sharing of visions and experience among all the actors concerned with the aim to concretise long lasting scenarios of durable development of the river or lake basins on the whole. The active participation of all the community (municipalities, people, businesses, associations, etc.) is one of the major challenges toward the complete implementation of the RBMPs for instance in Italy. The River Contracts are voluntary tools for the achievement of objectives of environmental quality not involving the adoption of compulsory legal or regulatory provisions. On the contrary, they require forms of public and private participation, representing the shift from a government to a governance approach. Thus these contracts do not constitute a further formal level of planning-programming of the territory, they do not establish novel administrative competences, nor do they create further procedural ties and linked investments of resources and they do not refer only to the river but to its basin as a whole. River Contracts are aimed to deliver a better coordination among the various decisional and planning levels, allow every subject to work within her own competences, and rationalize the use of resources already destined to the whole river basin, without asking for more funds. The main aim of the Contracts is the safeguard and the valuation of the water resources and the connected environments, that often results in concrete actions such as the reduction of the pollution of the waters, the restoration of the damaged aquatic ecosystems and landscapes and the sustainable use of the water resources.

More in detail, River Contracts are enacted through a multistep process whose steps and actions are represented in the table 2.3.

PREPARATION	ACTIVATION	ACTIVATION THROUGH THE TIME
Cognitive analysis of the territory Institutional and stakeholders involvement Preliminary Dossier and Protocol of agreement	Institutional concertation Privates involvement, population information Action Plan elaboration VAS Procedure Signature of the River Contract	Actions enacting following the indicated formality, responsibility, time steps and financial resources signed in the Action Plan At regime ordinary, integrated and participated water management at basin scale

Table 2.3 - Main steps of the River Contract application (Porro, E. 2010)

2.4.2 The role of woods and riparian vegetation[60]

The multi-functionality of Alpine forests is well recognized and documented. Alpine forests have a socio-economic role in supporting local economy, providing many useful services for tourist and recreational activities. Moreover, they play an important bio-ecological function that is maintaining biodiversity and preserving natural equilibrium of these fragile ecosystems. Alpine forests have also environmental function of protecting land and water resources. Based on their principal function and uses, alpine forests can be classified as: productive forests, protection forests, usable forests, naturalistic forests and forest with free evolution. Productive forests are managed following standard of wood production, while the other forests are managed according to the

[60] Terzuolo, P. G. (2010). *The forest planning and the woodland protection function: experiences in Piemonte Region.* Third Alpine Water Conference, Preparatory Workshop n. 2, Torino, Italy, 13th October 2010.

good environmental practices criteria. In the task of environmental protection of Alpine areas the protection forests play a key role. They have as their prime function the stabilization of slopes, prevention of avalanches, and protection of water quality, and also in riparian areas, where they stabilize sandbanks. In fact, woods are the best vegetation cover regarding runoff and soil-erosion reduction, landslide and avalanche prevention and as rock and snow fall barriers. Especially in large catchments the vegetation cover has very little to no influence on the resulting runoff. The smaller the catchment, the more effective is the positive runoff reducing forest influence.

Even if the primary role of forests in the environment protection has been recognized, the forestry practices continue to cause damages to the environment in the form of soil erosion, water quality deterioration, and other adverse effects due to the canopy openings and increased temperatures in the Alps. Climate change in the Alps impacted on the water balance of these regions as consequence of retreating glaciers that limited the river recharge during dry summer periods. The repent changes in temperatures and rainfall regimes impact on the forests growth and their physiological status altering the natural distribution of species in Alpine regions, with possible impacts on the regional and local economy.

However, the impact of climate changes on the multi-functionality of Alpine forests is still uncertain, thus the European scientific community started to analyse the relationships between climate change, the hydrological cycle and the Alpine forests. An existing experience of interregional cooperation concerning the sustainable management of protection forests over a small territory was made by research groups located in the Alpine regions of Italy and France within the INTERREG IIIA cooperation programme ("*Gestion durable des foréts de montagne à fonction de protection*"). During the following programming financial period 2007-2013, the research has been continuing between Italy and France, aimed to study management instruments and innovations to be applied to the protection forests in the western Alps. In the mentioned project the research group has proposed some innovative evaluation schemes that take into account all the involved factors (ecological, geomorphologic, hydrological and economic) in order to define the role of the protection and riparian forests in relation with the natural environment.

Figure 2.12 - Example of a not active (left) and of an active (right) management of the riparian vegetation (Terzuolo, P.G. 2010)

One Italian example of application in this field is represented by the study carried out by the Research Institute on Timber Plants and the Environment IPLA in support of the Piemonte Region with the aim to provide advices for the management of the riparian forests, in particular define the "technical addresses in matter of maintenance and hydrogeological and hydro-forestal settlement", approved in 2008; and the contents of some "Guidelines for the correct management of the riparian and flood-plain vegetation" to be applied to all the hydrological system of the Piemonte Region. A first report has been prepared on the matter, providing an innovative approach for the definition of the forest and of the river categories. The study is based on the evaluation of the wood characteristics in the different parts of the territory and aims to define where an active management of the forest can really deliver a protection effect, thus e.g. where the forest is resistant enough to last to a flood. An example of the different results obtained applying or not these active schemes for the riparian forest management is reported on figure 2.12.

Another project related to these aspects is MANFRED (Management strategies to adapt Alpine Space forests to climate change risks)[61]. The project was financed in the framework of the Alpine Space Program and is aimed at facing and managing the consequences of climate change on the multiple functions (ecology, economics, recreation, conservation) of Alpine forests. The main objects of MANFRED are defining how to cope with increased hazards and risks influenced by climate change and how to deal with extreme events due to

[61] Cetara, L. (2010). *The MANFRED project.* Third Alpine Water Conference, Preparatory Workshop n. 2, Torino, Italy, 13th October 2010.

climate alteration. The expected Project output are counteractive measures for mitigating the consequences of climate change or adapting Alpine Space to them, taking into consideration the needs of local population and of local or regional practitioners and stakeholders. More specifically, the two main aims of the MANFRED project are: 1) the protection and preservation of forest ecosystems, 2) risk prevention and effective management of forests. In this context, the project is intended to assess three specific objectives: the collection of knowledge on climate change effects on forests ecosystems, the identification of action requirements at a regional or local level and the development, cooperating with regional political decision makers, of the necessary adaptive strategies.

Through the application of these strategies it is expected that MANFRED Project will contribute to the goal of obtaining a sustainable development of environment and use of land, in the full respect of the needs of present and future generations. This will be done taking into strong consideration the EU Gothenburg priorities (2001) of protection and preservation of forest ecosystems as well as of risk prevention and effective management of forest ecosystems. Moreover, considering that climate change affects forests and mountain populations on a cross-boundary dimension MANFRED Project will be carried out by involving, when necessary, experts, students, practitioners and decision-makers from different countries of the Alpine Space creating an important Alpine cooperation group on the protection role of the forest.

Among the expected results, one of the most important is the production of a map that describes the original distribution and growth of main Alpine tree species and their modifications due to climate change, a "Forest Tree Species Atlas". The atlas will be supplemented by a map of trans-alpine seed zones for tree species and a Handbook of "Alternative, Adapted Seed Sources". Moreover, a monitoring network for pests and pest complexes and a guide ("Pest Management") for forest owners and decision makers will be created, and extreme events and hazard scenarios (storm, fire, drought) maps are further expected results. Other important expected results are the creation of a complete database of extreme forest damage events due to climate change climate change occurred in the Alpine Space. The creation of a compendium of alpine-wide standardized protection indicators and guidelines on the protective effects of forests in natural hazards assessment is also envisaged. All these

expected results should provide help in managing forest ecosystems through direct involvement of their target groups, that is to say, local authorities, public administrations, forest administrations, forest owners and practitioners, landscape managers, political decision makers.

2.4.3. Water cycle and the ecological functions of forests: a new approach to the analysis of the ecological-economic value of a river basin [62]

Ecosystemic services have become a widely debated topic of study in the research on ecosystems in recent years, and many authors have underlined the importance of the economic evaluation of services offered by the nature (Costanza et al., 1997; De Groot et al. 2002; Farber et al., 2002, Howarth and Farber, 2002; Limburg et al., 2002) as a tool for an efficient allocation of environmental resources (Heal et al., 2005, MEA, 2005). "Ecosystem services" (Ehrlich & Ehrlich, 1981) mean the many ways in which ecosystems support life and contribute to human well-being, essentially impossible to be encompassed in a definitive classification (TEEB, Chapter 1, 2010). Extremely simple but effective, the Millennium Ecosystem Assessment (MEA, 2005) defines these services "the benefits that humans derive from nature". Among them, is therefore correct including goods such as food resources, water, air, soil, raw materials, genetic resources, etc., as well as services produced by the different elements of the ecosystems and the results of their functional interrelations, e.g. natural purification and maintenance of water quality, water supply, protection from erosion and flooding, soil formation, regulation of runoff, fixation of atmospheric carbon, etc..

In this context, areas covered by vegetation play a key-role in regulating the water cycle having therefore a fundamental role in the water balance of a river basin. An area where the vegetational cover is an important structural and diversification element even in its agro-ecosystems, has often an added value in terms of quality and a positive economic budget in comparison with areas in

[62] Santolini, R. and Cetara, L. (2011). *Water cycle and the ecological functions of forests: a new approach to the analysis of the ecological-economic value of a river basin*. Written contribution

which the resource has been depleted. This loss, in fact, may have a negative impact on public finances through active costs to be incurred in order to recover hydrogeological instabilities, landslides, loss of soil, water purification etc. that, in the presence of functional ecosystems, would be considerably more contained.

For these reasons, the current economic quantification of the value of the ecosystem services offered, for example by forest systems, impacts on the economic assessment of water cycle and allows the assessment of the forest not only as a direct resource (e.g. source of timber for industrial uses, construction and energetic uses; recreation facilities), but also for its contribution to the provision of public goods such as protection of watersheds and climate regulation (ecosystemic services). Many of these functions are currently used by men for free and in the absence of a full awareness (TEEB, 2010), but they take a significant economic burden when considered within an ecological-economic approach (Santolini, 2007). In fact, the availability of "Natural Capital", a primarily ecological concept although constructed by analogy with the one of economic capital[63], becomes the key of the economic-territorial comparison and of the recognition of those human activities compatible with the maintenance of the quality of functions and services provided by ecosystems, which in the case of forests are mainly due to vegetation cover and in particular this of woody-shrubby. The results of analysis about the functionality of ecosystems, the current and potential use of their services and the marginal value of flows and stock of natural capital (ecosystems) that determines the aggregate of services, at present, are only partially available. These results may become an important tool for assessing the quality of the landscape and the ecological functionality and guiding land management policies that at present, for the most part, do not consider all the environmental, social and economic benefits of such services, nor they take

[63] "Natural capital" is defined by the Millennium Ecosystem Assessment an "economic metaphor for the limited stock of physical and biological resources available on the planet" (MA, 2005), recognizing at the same time its ecological nature and its economic inspiration. The strong type of sustainability assumes that the stock elemets of naural capital cannot be substituted by the man-made capital (Musu, 2008). In fact, some of the ecosystem functions and services are quantitatively and spatially essential for the survival of the humankind being crucial elements for the survival of life itself: this share of capital is called “Non-Replaceable Critical Natural Capital” and thus in need of different kind of protection (long-lasting/durable development).

into account the costs arising from degradation and loss of ecosystems - by any metric they are actually evaluated.

Proper management of vegetational capital, in fact, guarantees the maintenance of functions for the regulation of the water cycle and soil erosion within a river basin.

Anyway, it should be noted that many of the services provided by ecosystems do not have a direct value of market. In general, in economics, an economic value exists only if the benefits of a resource or the enjoyment of a service have been recognized and it is possible to make an exchange in order to get such enjoyment. You can, however, even in the absence of explicit recognition of this economic value on the market, to attempt an estimate, intended to clarify the dependence of human well-being from ecosystemic services and that considers, in addition to direct benefits (direct use values), the indirect ones (indirect use values) and those of non-use. On the basis of the functions that forests play, for example, territory can be assessed in terms of maintenance and/or consumption of natural capital of reserve, which is the so-called "*Critical Natural Capital*", understood as a pool of natural resources needed to maintain quality and quantity level of services to serve the welfare and survival of human and non-replaceable with other forms of capital (Barbier, 1994; Daly, 1997; Prugh, 1999, Daly & Farley, 2004; TEEB, 2010).

To estimate the indirect value of ecological services, several techniques can be used. The concept of "Total Economic Value" (Turner et. al, 1996; Pearce, 2001; Cavatassi, 2004), applicable to each ecosystem, represents an attempt to overcome the traditional approach to the evaluation of environmental goods based exclusively on the value of use, linked to the recognition of a benefit for the advantage of final consumers. This paradigm allows to take into account both the value of use of an environmental good, generally more easily assessed, and its non-use value, which refers to the inherent benefits, arising from the mere existence of the good.

In the case of river catchment areas have been used, for example, independent techniques, i.e. the estimate of the demand of the ecosystem services, the "replacement cost" and "avoided cost" (Gunatilake and Vieth, 2000; Brauer and Marggraf , 2004, Ming et al., 2006) which use 1) the costs of replacing an ecosystem or its services, calculated as a *proxy* for the value of the service itself

or 2) the cost of the actions taken to avoid damage, as a measure of benefits guaranteed by the presence of the ecosystem (which is part of the family of the costs of mitigation). These techniques are useful for evaluating the indirect (hidden) value of ecosystem services (biodiversity, water cycle regulation, erosion) mainly linked to the ecological characteristics of the territory.

The analysis of river basins (Morri and Santolini, 2011) makes it possible to evaluate some regulatory services of the water cycle within the considered river basin, such as purification and regulation of water on the base of the rainfall/evapotranspiration balance, soil erosion, absorption of $C0_2$, in order to build a territorial scenario that highlights the economic significance of the ecological functions. Instead, among cultural services and amenities/aesthetic values - according to the TEEB classification (TEEB, 2010) - is also part of the landscape quality of the river basin that can be associated to the preservation and sustainable development of those areas that keep functional goods and services also for human well-being and its activities, in a complex system of interactions, according to which some services act as inputs for the production of others (Boyd & Banzhaf, 2007; Wallace, 2008; Fisher & Turner, 2008; Balmford et al., 2008), which can also affect areas geographically distant from the areas responsible for the production of services in analysis, for example coastal areas than rivers flowing in mountainous areas. The maintenance of the functions of these ecosystems can be recognized both as a generator (also indirect) of the economic value, and having intrinsic economic significance in itself and not immediately replaceable with an aleatory compensatory contribution. This criterion becomes an instrument of “territorial equalization” that is important for planning of those contexts where there are economic and ecological imbalances between an area characterized by a mature and energy-based industrial development (coastal touristic areas or industrial districts) and hilly and mountain areas rich of functions and resources-provider. The application of PES forms certainly can:

- rebalancing energetic flows on the whole territory reallocating functions and richness,
- defining sustainability thresholds,
- activating restoring processes of the exploited and alterated resources.

2.4.4 Artificial snowmaking: economic, social and environmental aspects [64]

In the recent years the increase of the technical snowmaking facilities in the Alps has been significant. In Austria, the total skiable terrain equipped with snowmaking facilities increased from 20% in 1991 to 50% in 2007; Switzerland experienced an increase from 1,5% (1990) to 18% (2006). In Germany as well as in the French and Italian Alps, the increase was 30% or more, reaching around 11,5%, 15,5% and 40% by 2004, respectively. In 2004 the area with snowmaking facilities amounted to 25% of the total Alpine skiable area (RSA II, 2009 on the basis of the OECD, 2007, publication[65]). Figure 2.13 and figure 2.14 show the spatial distribution of the technical snowmaking facilities in the Alps in 2009 (Source: SNTF[66], 2009). This growth is expected to continue in the near future, as considerable investments are currently being undertaken (RSA II, 2009).

Water requirements for snowmaking can be substantial at a local level, using a considerable share of the annual water abstraction, and can lead to water conflicts especially in the winter season in areas where snowmaking stations are connected to the drinking supply network, causing temporary water shortages. However, from the point of view of the regional and Alpine-wide water resource balance, artificial snowmaking is not a significant issue. Considering the total estimated amount of water used for snowmaking in the entire Alpine region, this would correspond to only 1,5 – 4% of Swiss water consumption. Artificial snow production can also have significant ecological impacts on vegetation, soil, animals and aquatic ecosystems. Impacts largely differ in consideration of regions, elevation etc.. More details on these aspects can be found in the RSA II (2009) study.

[64] Paccard, P. (2010). *Artificial snowmaking: economic, social and environmental aspects*. Third Alpine Water Conference, Venice, Italy, November 25th-26th, 2010.

[65] OECD (2007). *Climate Change in the European Alps – Adapting winter tourism and natural hazards management,* OECD Publishing. (comparison of figures based on various sources).

[66] Syndicat National des Téléphériques de France (2009) – *Les domaines skiables face au changement climatique.* Domaines skiables de France n.21.

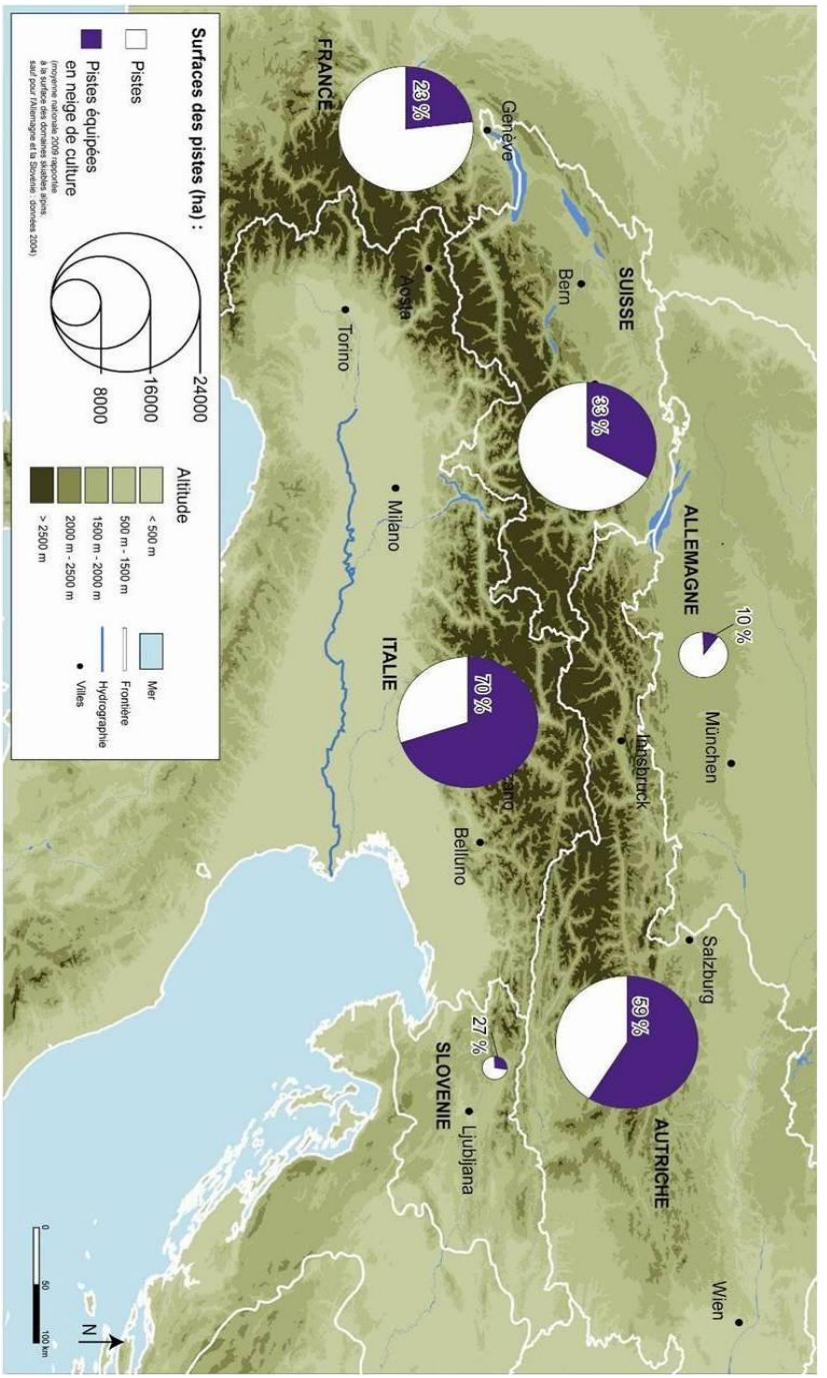


Figure 2.13 - Artificial snowmaking: % of the surface of ski runs covered by snowmaking facilities: map (SNTF, 2009 & Paccard, P. 2010)

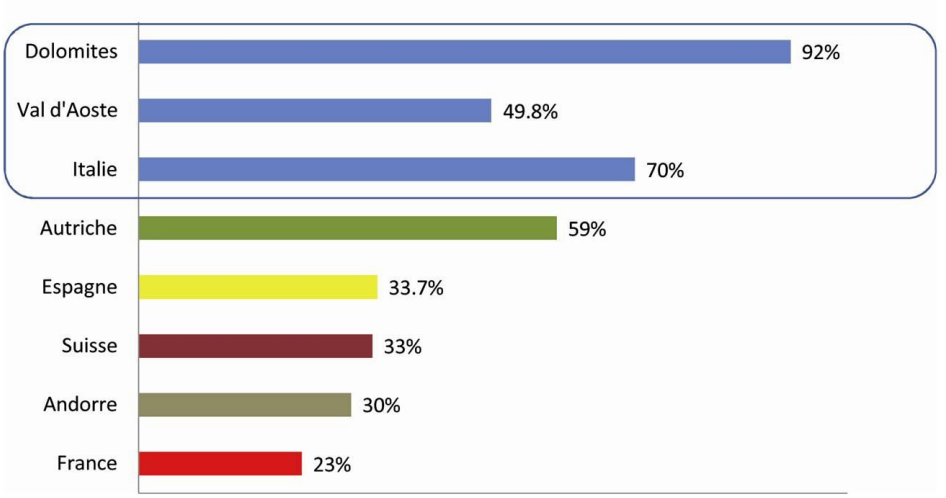


Figure 2.14 - Artificial snowmaking: % of the surface of ski runs in some European countries and regions (SNTF, 2009 & Paccard, P. 2010)

The case of artificial snowmaking in France

Artificial snowmaking in winter ski resorts, and in particular its impacts on water resources, receive a substantial cover from local media in the French Alps. A recent French publication by the French National Council of Environment and Sustainable Development[67] clearly identifies the current concerns about artificial snow and recognizes that snow making is effectively the centre of strong stakes, on one hand about management and protection of the water resources and on the other hand about the future of tourist sector development.

Snow production is a mass tourist service, which was mainly developed after the Second World War in France. Ski lifts exploitation in French ski resorts generated more than 1 billion Euros turnover for winter 2007-2008. French ski areas, which count 300 resorts, are some of the most frequented ones in the world, behind Austria and USA, with an amount of 58,5 million ski days for the winter 2008-2009. This global data gives a good idea of the importance of winter tourism in French mountain territories (figure 2.15).

[67] Badre, M., Prime, J.L., Ribiere, G. (2009). *Neige de culture: Etat des lieux et impacts environnementaux Note socio-économique.* Conseil général de l'environnement et du développement durable.

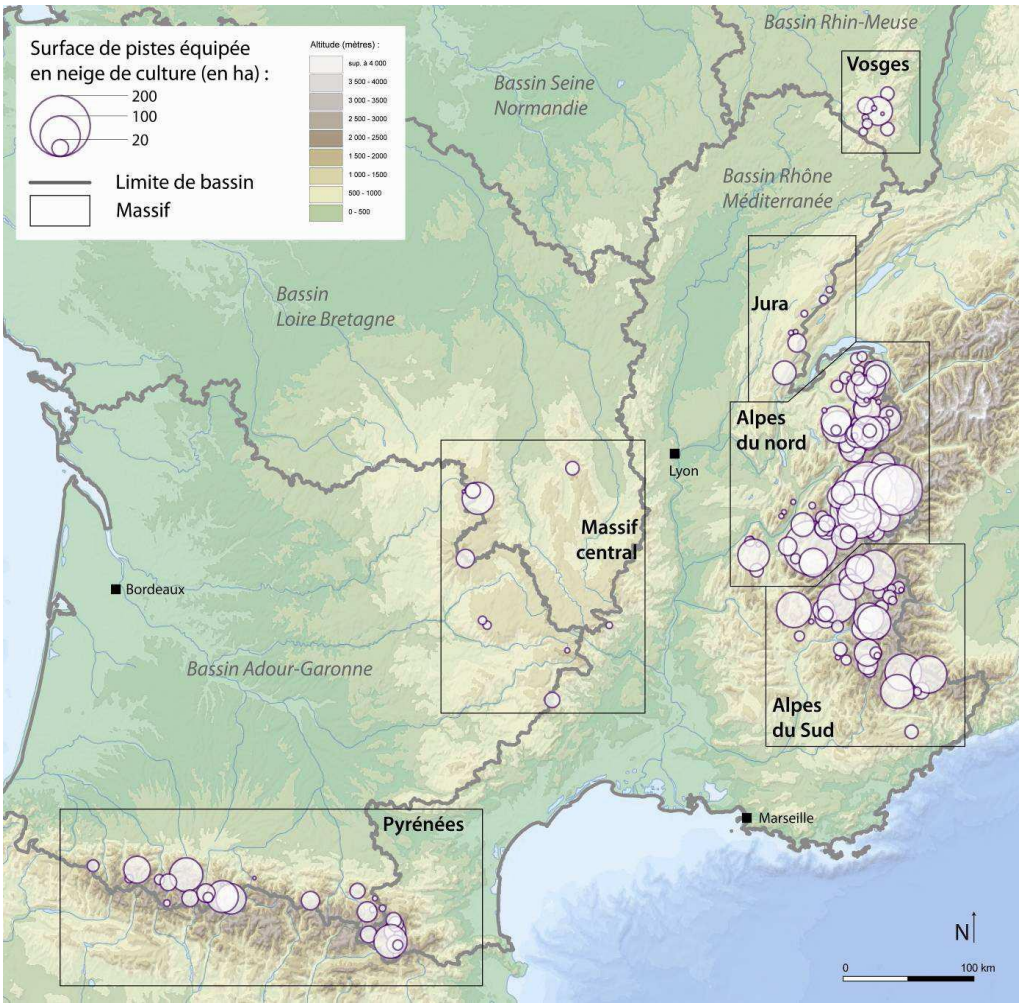


Figure 2.15 – Map of artificial snowmaking surfaces at French scale (Data ODIT France, 2009) [68]

In order to guarantee this economic activity against the snowfalls variability, ski lifts operators invested since the 1980s in artificial snowmaking machines. A succession of "bad winters" in the 1990s marks the acceleration of this equipment policy. Today, after a spectacularly fast development, more than 65% of the ski resorts located in the French Alps are equipped, and the average of the equipped ski run surfaces is about 25%.

[68] ODIT France (2009) *Les chiffres clés du tourisme de montagne en France* - 7ème édition.

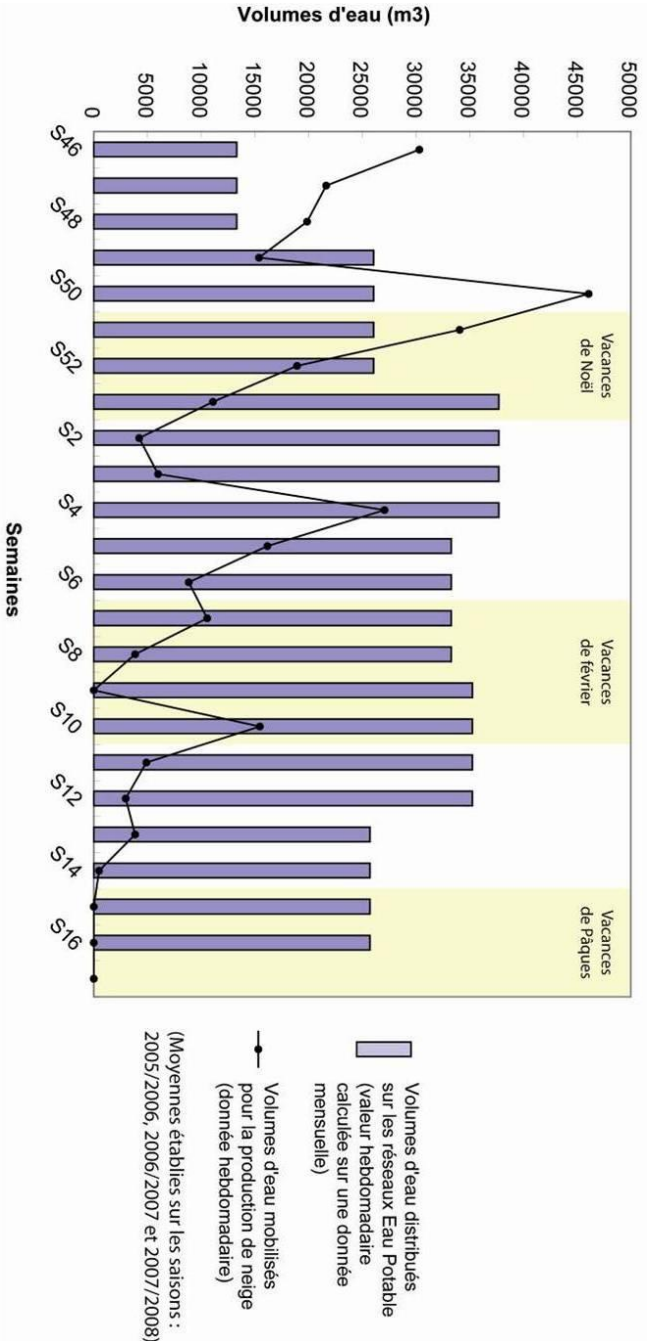


Figure 2.16 – Trends in drinking vs. snowmaking water consumption in Courchevel (Data: S3V / St. Bon)

Producing snow consists on pulverizing a mixture of air and water under pressure in the cold air; droplets so formed crystallize, then settle on ski runs. On average, 3500 mc of water are necessary to cover one hectare of a ski run during a season (figure 2.16). This water needs are important at the scale of the small mountain watersheds, in particular during the low water level of the rivers in winter. Thus, the problem is to conciliate needs for artificial snow with the other water uses, with the necessity to maintain the aquatic environments in a good ecological state.

Besides, within the framework of climate change, the expensive investments in installations of snow production go beyond the question of water. Their relevance on the long term can be questioned, in particular at medium altitude, where the rarefaction of snow resource caused by higher temperatures could force to rethink the model of tourist development (figure 2.1Figure 2.7).

In any case, artificial snow needs to be implemented in the respect of the natural balances (water resources), economic (return on investments) and social (impact on the price of the product ski). In fact, the projects on artificial snow coverage must be carefully studied towards a local territorial context (assets and constraints) to verify the compatibility with the stakes of the sustainable development.

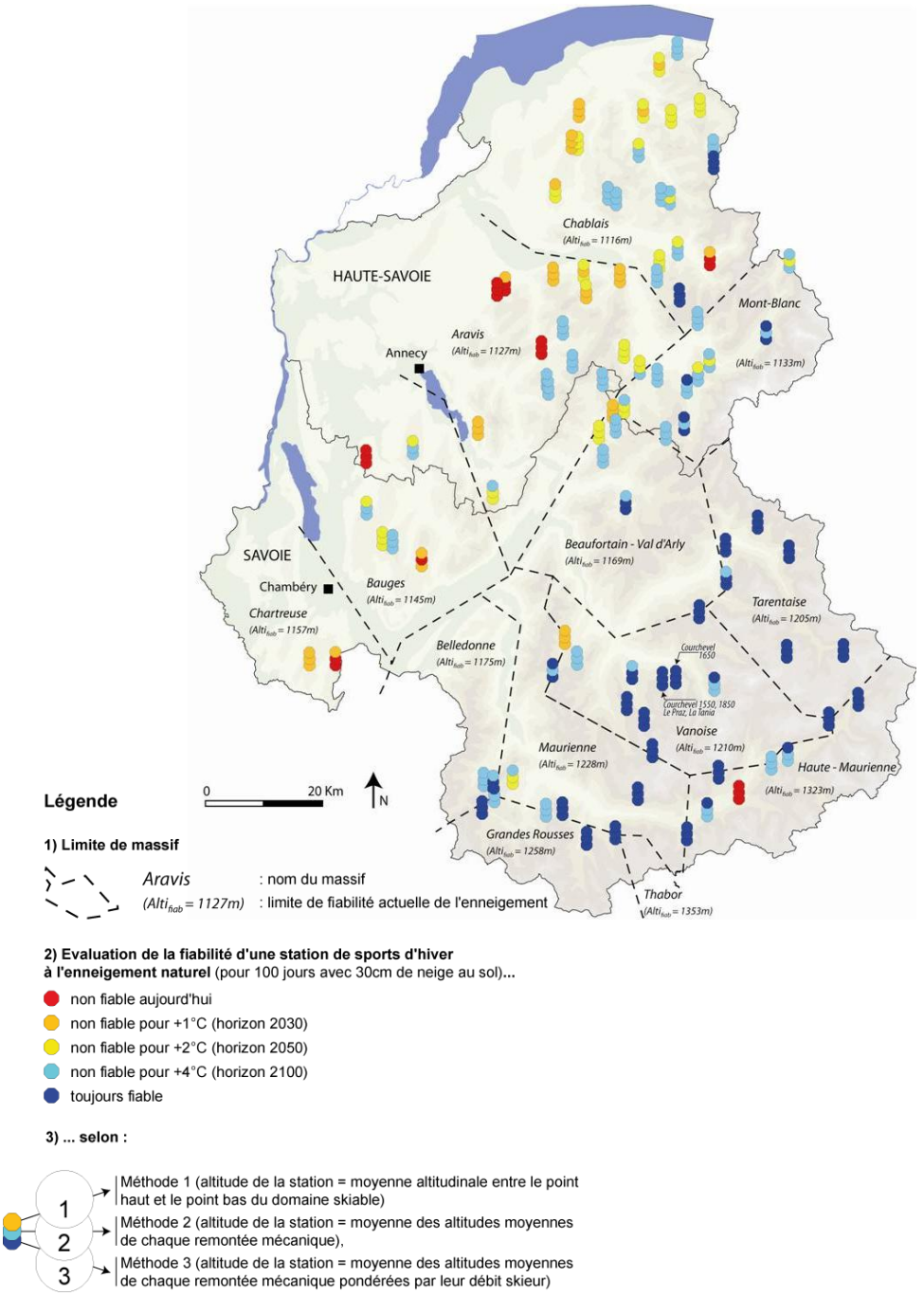


Figure 2.17 – Snow cover vulnerability of ski resorts in Savoie and Haute-Savoie (Paccard, P. 2010)

3 HYDROPOWER GENERATION IN THE ALPINE REGION*

* Text reviewed, based on the presentations exposed at the 3rd session of the 3rd International Conference "Water in the Alps", Venice, November 25th and 26th, 2010, and at the Preparatory Workshop n.3 "Hydroelectric energy production: ecological, economic and social aspects", Sondrio, October 26th, 2010.

3.1 The hydropower generation in the Alps and future trends [69]

3.1.1 The hydroelectric production

Due to their high abundance of water, one of the principal industrial interests of the Alpine area is the use of energetic potential of water.

The role of water is essential for energy production and in particular for hydropower. While in the past the energetic potential of water was used to reduce manpower (e.g. flour, saw or hammer mills operation technologies) in order to meet localized energy needs, in the last century, the modern hydropower plants for energy production replaced the "primitive uses" of water as mechanical power to satisfy the energy needs of larger areas . The reason for the attractiveness of hydropower generation in the Alps can be found in the perfect pre-conditions: steep slopes in combination with high precipitation, which can exceed 3.500 mm per year in some areas[70].

In 2009 the 2nd Report on the State of the Alps reported that nowadays about 550 hydropower stations with a bottleneck capacity bigger than 10 MW are located in the Alpine area (figure 3.1). As highlighted in the table 3.1 the total power output of those power stations is more than 45.800 MW.

[69] Platform Water Management in the Alps of the Alpine Convention (2010b). *Situation Report on Hydropower Generation in the Alpine Region focusing on Small Hydropower.* Draft for discussion at the Third Alpine Water Conference.

[70] For additional information on hydropower generation in the Alps, see chapter B 3.4 of the RSA II, 2009. Alpine Convention (2009). *Water and water management issues. Report on the State of the Alps*. Alpine Signals - Special Edition 2, Innsbruck, Permanent Secretary of the Alpine Convention.

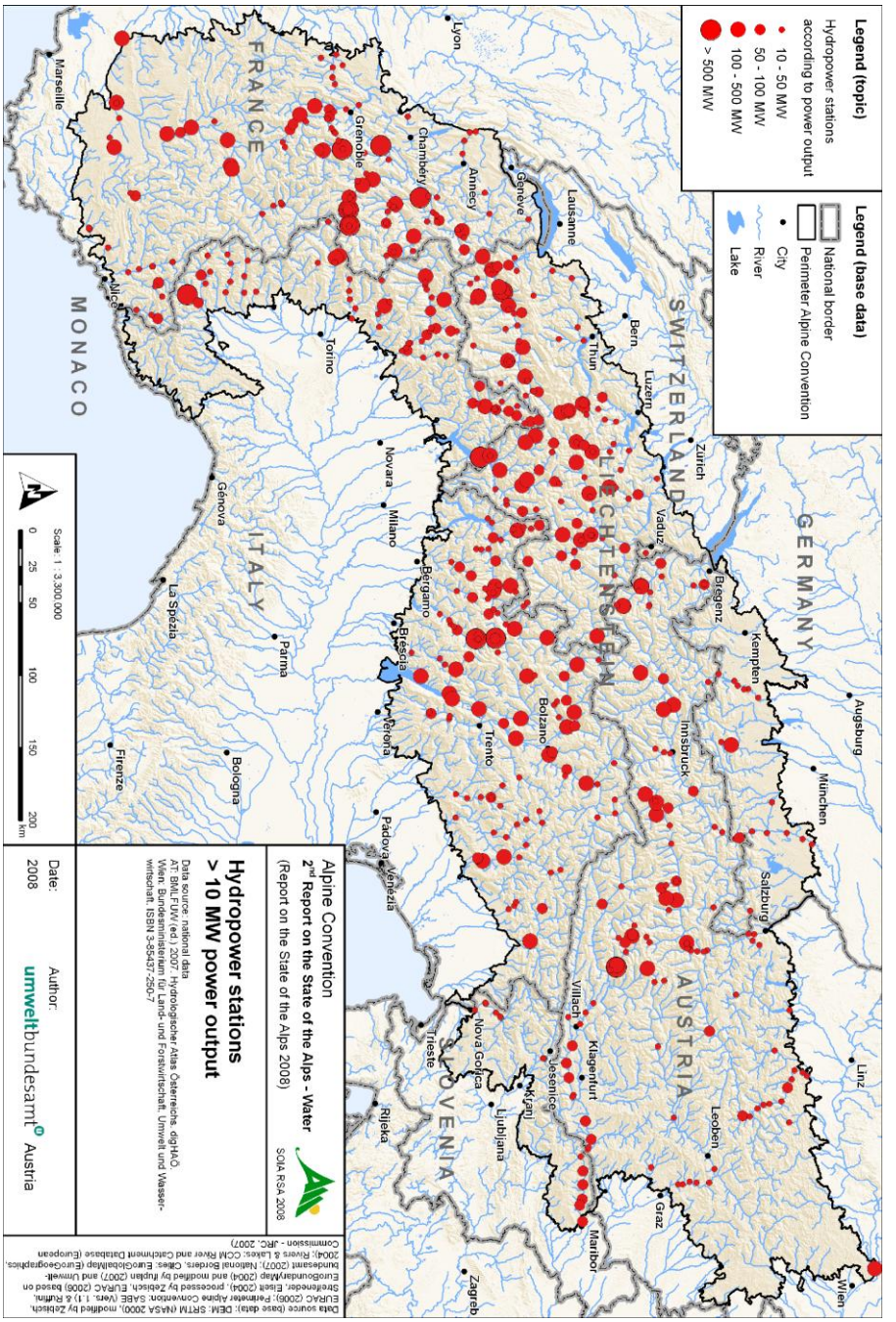


Figure 3.1 - Map of large hydropower stations with capacities of more than 10MW in the Alps (RSA II 2009)

Table 3.1 - Number and power in MW of hydropower stations (power output >10 MW) in the Alps (RSA II 2009)

Country	Number of Hydropower Stations (Power Output > 10 MW)[76]	Total Power Output in MW of Hydropower Stations (Power Output > 10 MW)
Austria	112	8.235
France	128	12.552
Germany	16	523
Italy	169	14.403
Slovenia	12	516
Switzer-land	117	9.654
Sum Alpine Arc	**554**	**45.883**

In addition to the large hydropower stations there are thousands of smaller ones with capacities of less than 10 Megawatt. Figure 3.2 gives an example of the location of large and small hydropower in Slovenia, which represent a recurring feature in the alpine region as a whole.

Currently there is no international agreement on a technical threshold value that define the limit between small and large hydropower (Table 3.2) but it is defined in the legal frame of the individual countries. The most used threshold value in the Alpine regions is the bottleneck capacity of 10 MW, that is the same value employed by statistical agencies at European level (e.g. Eurostat). However, the definition of a common threshold value can be relevant for gaining investment support or guaranteed feed-in tariffs, environmental legislation like e.g. the EU Water Framework Directive. On the other hand the last EU Directive does not make any differences between small and large hydropower stations.

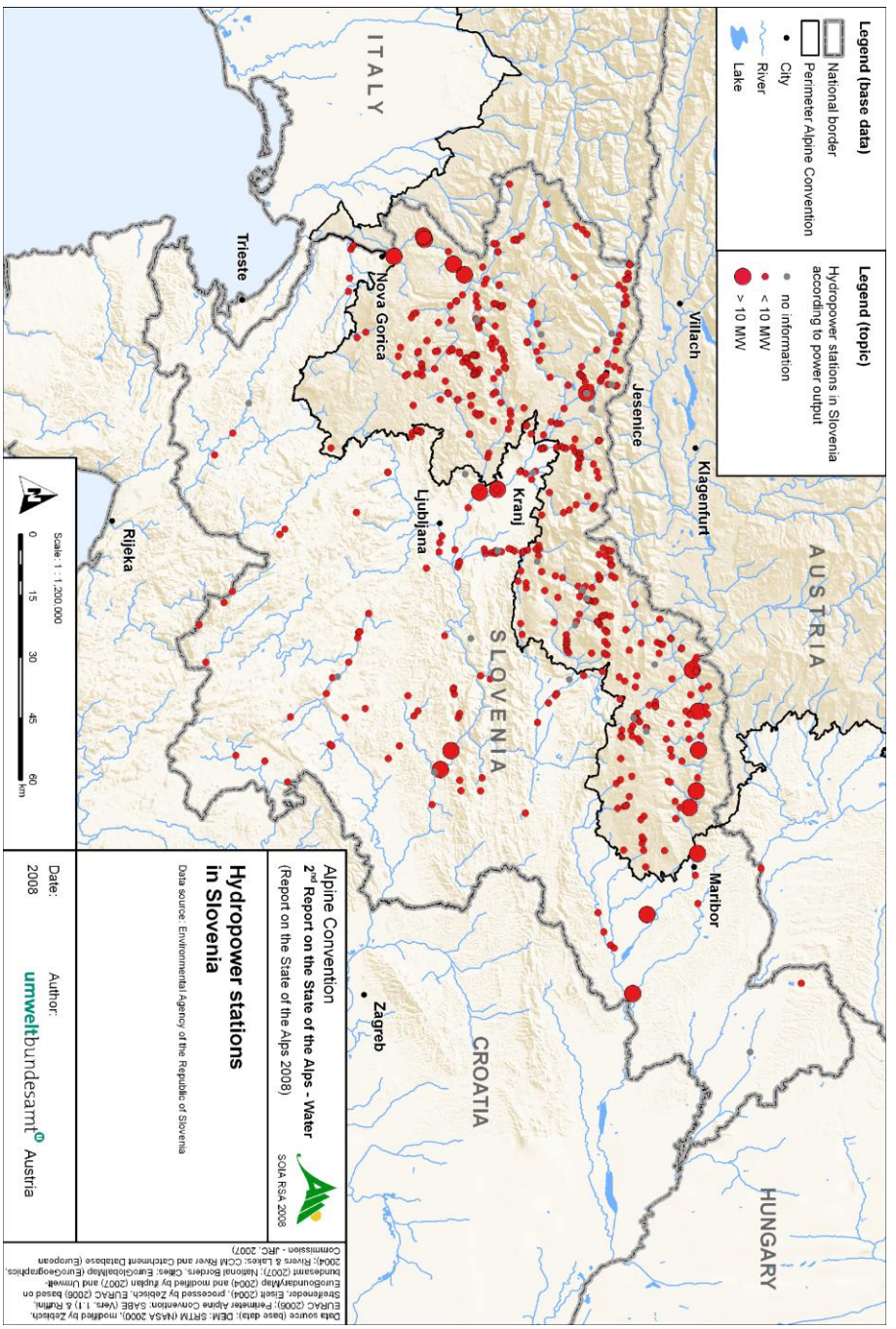


Figure 3.2 - Map of hydropower stations (by category of power output) in Slovenia (RSA II 2009)

Table 3.2 - Overview on the threshold values for the definition of "small hydropower" in the Alpine countries (Platform Water Management in the Alps 2010b)

COUNTRY	THRESHOLD VALUE FOR DEFINITION SHP [MW]
Austria	< 10 MW
Germany	< 1 MW
France[71]	Multiple definition: < 4,5 or < 10 or < 12
Italy	Double definition: < 1 or < 3 MW
Slovenia	< 10 MW
Switzerland	< 10 MW
Liechtenstein	< 10 MW
Monaco	No hydropower

In the year 2010 more than 21.000 small hydropower plants were in place in the EU-27 Countries. As reported by ESHA[72], those small stations contribute with a total installed bottleneck capacity of over 13.000 MW producing 41.000 GWh electricity per year. Moreover, in the EU-27 Countries over 90 % of installed capacity is concentrated in six Member States: Italy (21 %), France (17,5 %), Spain (15,5 %), Germany (14 %), Austria (9,4 %) and Sweden (7,7 %). Small hydropower has also significant relevance in the non-EU Countries (Switzerland and Norway).

In the Countries where the landscape is mainly dominated by mountain (e.g. Switzerland or Austria), hydropower contributes significantly to electricity generation, up to nearly 60% of the total electricity generated within the borders of the individual Countries (in the case of Liechtenstein even more than 90%). Figure 3.3 shows the total electricity production for renewable sources, including hydropower, and non-renewable sources, and the electricity production only from hydropower (small and large) in the reference year 2005 for the individual Alpine Countries (total area).

[71] SHERPA, 2008b. Strategic Study for the Development of Small HydroPower (SHP) in the European Union. SHERPA – Small Hydro Energy Efficient Promotion Campaign Action.
[72] Gollessi, S. (2010). *The point of view of the producers*. Third Alpine Water Conference, Venice, Italy, 25th-26th November 2010.

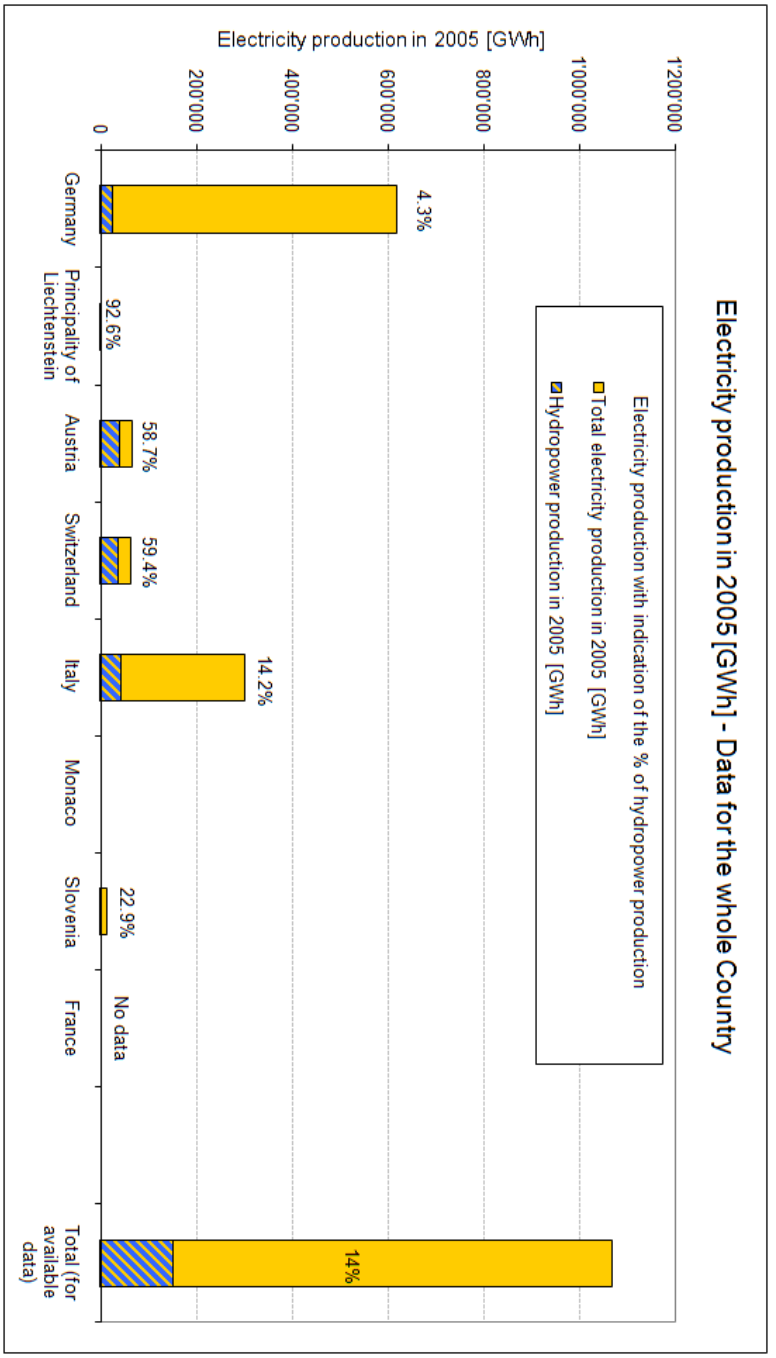


Figure 3.3 - Electricity production in the Alps by country (2005) with indication of percentage of hydropower production (Platform Water Management in the Alps 2010b)

Here in the following a brief overview on hydropower production and the number of facilities in the Alps is given. Data regard the share of the Countries within the Alpine perimeter and refer to the year 2005. Data are split into 5 categories based on the bottleneck capacity of the individual hydropower stations and are provided both in absolute (Figure 3.4 and Figure 3.5) and in relative numbers (Figure 3.6 and Figure 3.7).

The stations of the category larger 10MW ("large hydropower") contribute mainly to the generation of energy. With reference to the total electricity produced by hydropower, large hydropower can supply more than 90% of energy in some Countries, e.g. in Switzerland, and more than 70% for other Countries (figure 3.8).

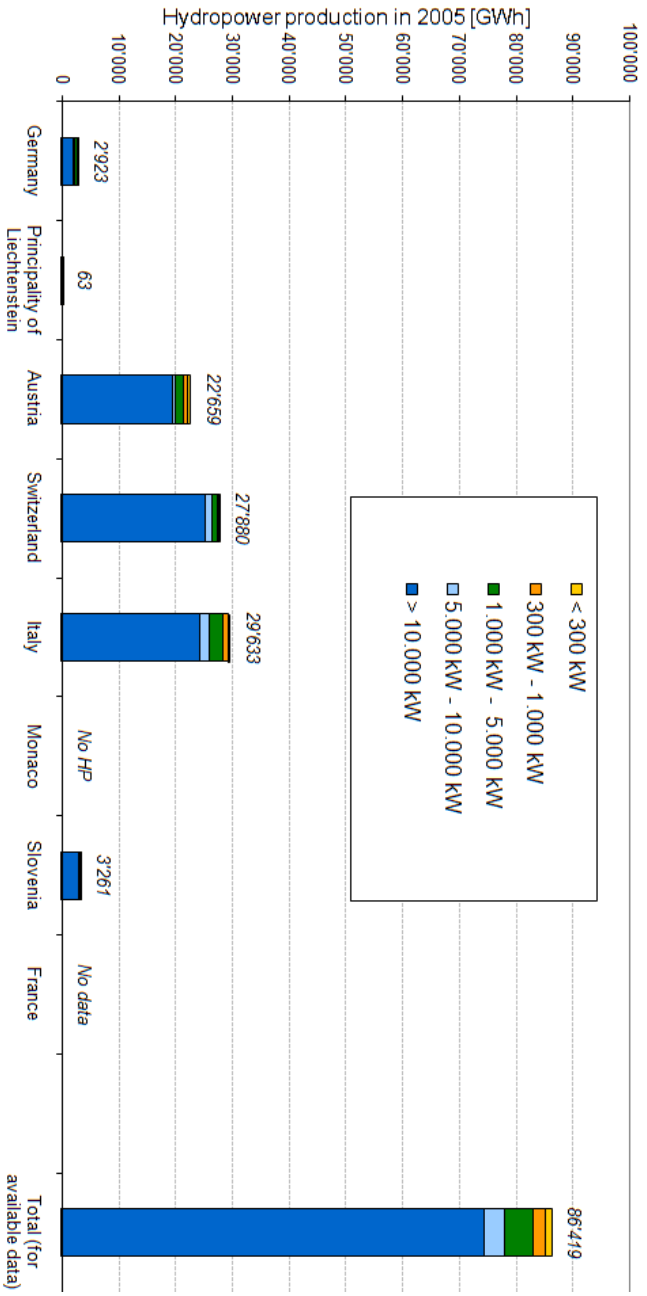


Figure 3.4 - Hydropower production (GWh) in the Alpine countries, within the area of application of the Alpine Convention (2005), for different categories of hydropower stations. (Platform Water Management in the Alps 2010b)

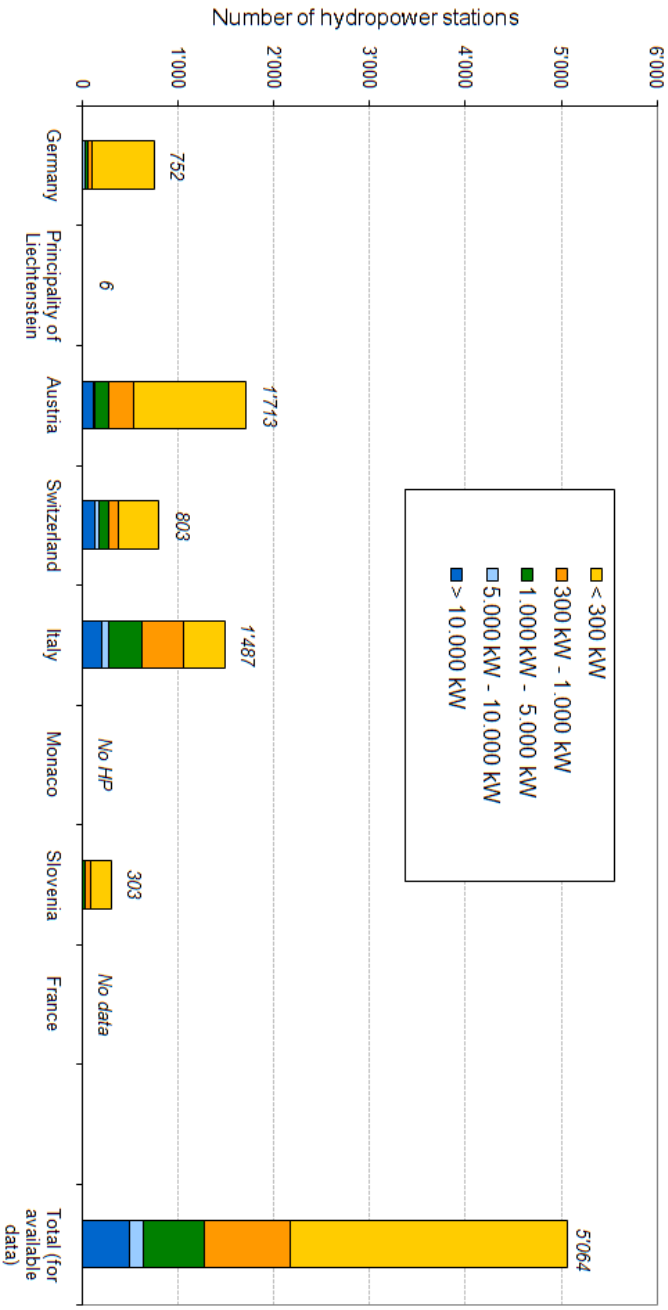


Figure 3.5 - Number of hydropower stations in the Alpine countries (absolute distribution), share within the area of application of the Alpine Convention (2005), for different categories of hydropower stations (Platform Water Management in the Alps 2010b)

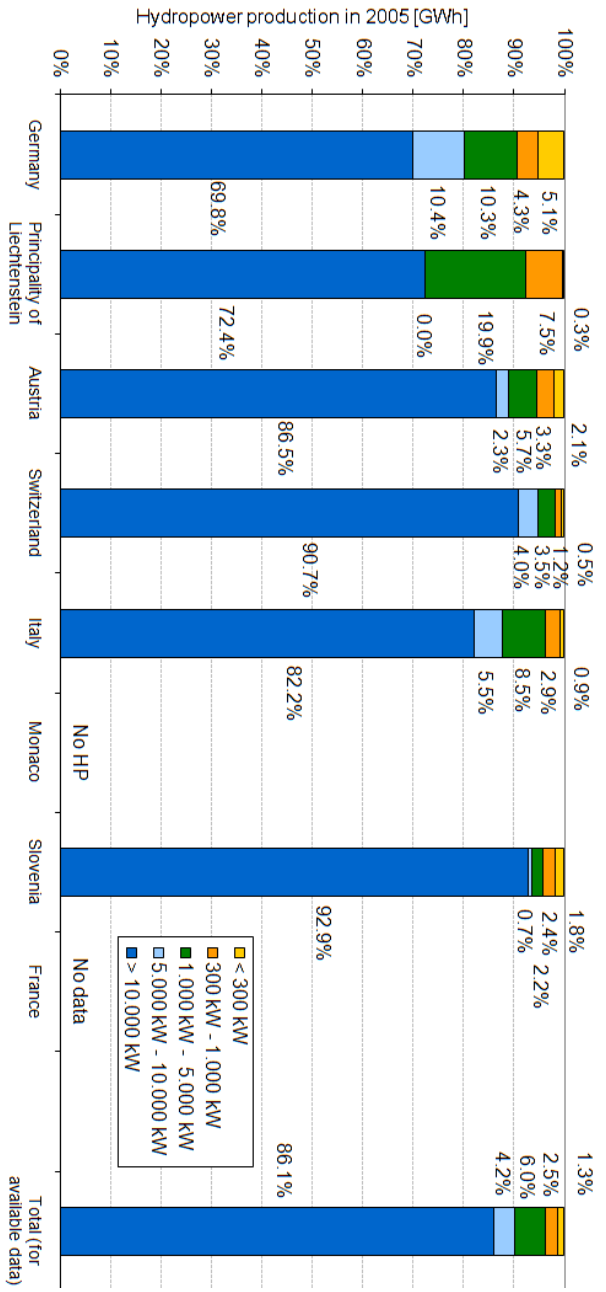


Figure 3.6 - Hydropower production (GWh) in the Alpine countries, within the scope of application of the Alpine Convention (2005), for different categories of hydropower stations (Platform Water Management in the Alps 2010b)

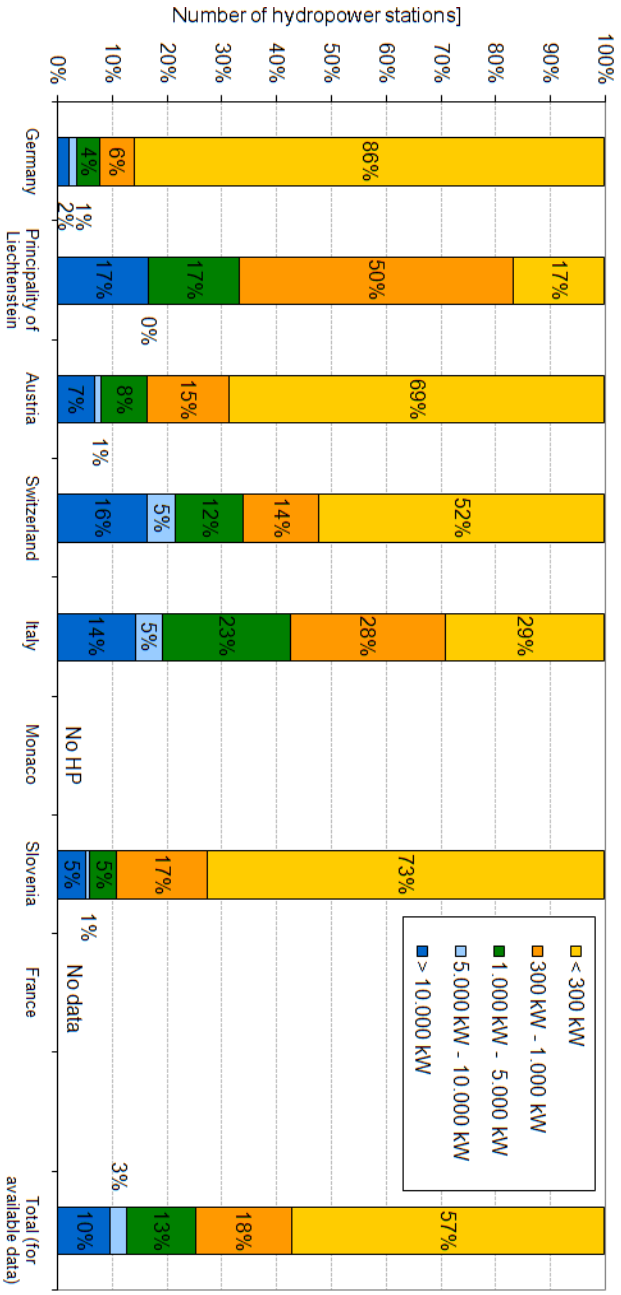


Figure 3.7 - Relative distribution of hydropower stations in the Alpine countries, within the scope of application of the Alpine Convention (2005), for different categories of hydropower stations (Platform Water Management in the Alps 2010b)

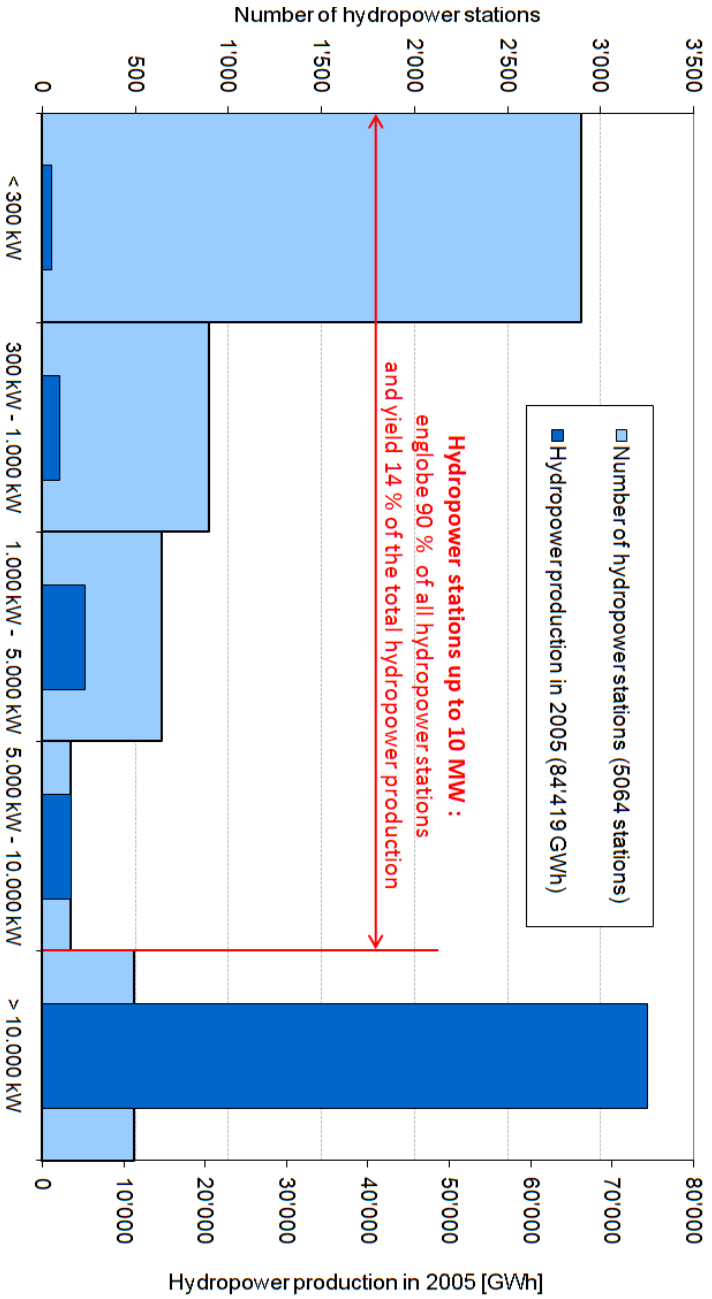


Figure 3.8 - Number of stations and hydropower production within the scope of application of the Alpine Convention (Platform Water Management in the Alps 2010b)

Regarding the number of hydropower stations, Table 3.3 highlights the big number of small facilities, particularly of the very small (micro) stations with a bottleneck capacity lowest than 300 kW.

Table 3.3 - Relation between number of hydropower stations and hydropower production within the scope of application of the Alpine Convention (Platform Water Management in the Alps 2010b)

	CATEGORY OF HYDROPOWER STATIONS (BOTTLENECK CAPACITY)				
	< 300 kW	300 - 1.000 kW	1.000 - 5.000 kW	5.000 - 10.000 kW	>10.000 kW
Production [%]	1,3%	2,5%	6,0%	4,2%	86,1%
Stations [%]	57,2%	17,6%	12,6%	2,9%	9,7%

As reported by Figure 3.8, in the Alpine perimeter the number of facilities is 5064 and the contribution to the total electricity generated by hydropower is 84.429 GWh. Most part (86,1%) of the electricity is generated by large power stations (bottleneck capacity of more than 10 MW) that represent 10% of the total number of hydropower stations.

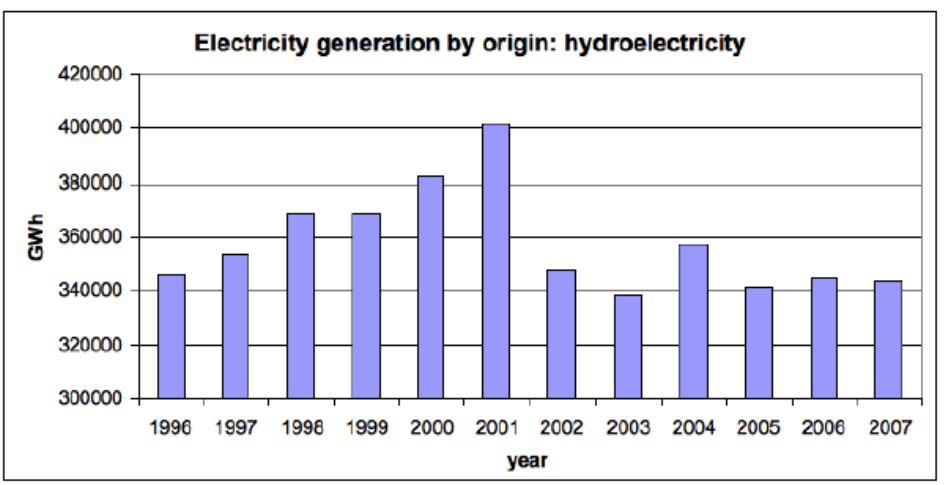


Figure 3.9 - Hydroelectric electricity generation in Europe (Eureau 2009)

The stations with bottleneck capacity of less than 10 MW ("small hydropower") represent about the 90% of all stations but they generate only about the 14% of the total electricity produced by hydropower. Inside this category, middle-sized stations (bottleneck capacity between 1 and 10 MW) contribute at about the 10% of the total electricity generated by hydropower.

The 57% of the small stations have bottleneck capacities of less than 300 kW and contribute to the electricity production with a share of about 1%.

Table 3.4 - Targets for renewable energies in Alpine countries (Platform Water Management in the Alps 2010b)

Targets for renewable energies[73]		
Country	**Share of energy from renewable sources in gross final consumption of energy, 2005 [%]**	**Target for share of energy from renewable sources in gross final consumption of energy, 2020 [%]**
Austria	23,3	34
France	10,3	23
Germany	6,7	20
Italy	5,2	17
Slovenia	16,0	25
Switzerland	The goal of Switzerland's energy policy is to increase the proportion of electricity produced from renewable energy by at least 5'400 GWh by 2030, which corresponds more or less to an increase of 10% of the country's present-day electricity consumption. To this target, the contribution from hydroelectricity production shall be at least 2'000 GWh.	
Liechtenstein	17	For 2020 no precise goals are set at the moment.

Even if the share generated is of about the 14% of the total hydro-electricity produced in Alpine Countries (Table 3.3), the contribution of small hydropower plants to the overall electricity generated in the Alpine perimeter is limited (see Figures 3.3 to 3.9). Therefore it is plausible to ask if the national financing for

[73] Targets for renewable energies as set for EU Member States in Annex I of directive 2009/28/EC and in Swiss Federal Energy Act (EnG, dated 26 June 1998; SR 730.0)

very small and micro hydropower plants can really contribute to the increase of the share of renewables. It is realistic that electricity produced by small hydropower can represent a more significant contribution at the local level as for the small villages of the Alps.

With regard to the future trends, the production of electricity by hydropower decreased from 2002 until today, in particular has reached its the absolute low point during dry and hot summer 2003 (Figure 2.3). Consequently, starting from 2004 several reforms have been undergone to regulate the energy market constrained by the energy demand (Alpine Convention, 2009). Therefore, the energy demand plays a key role in the Alpine water management contributing to the developments of hydroelectric sector in the Alps. Furthermore the continuous increase of the energy demand goes together with the rising of the fossil fuels prices. Nowadays, as a result of the trend of electricity prices the industry start to invest in new hydropower projects and facilities. It is then expected that hydroelectricity will grow up in the next decades, according to the projections for global energy consumption (DOE, 2006)[74].

According to the forecasts made by the Intergovernmental Panel on Climate Change (IPCC, 2007) [75], future climate trends will impact on hydropower sector and electricity production and there will be a reduction of 25% of hydropower potential in southern and south-eastern European Countries and, on the contrary, an increment in Nordic Countries (e.g. 15-30% in Scandinavia and Northern Russia).

With regard to future trends it has been considered that, the potential for the generation of electricity from hydropower in the alpine region has already been developed to a considerable extent, however the expected trends with regard to the hydropower production are strictly connected to the Renewable Energy Policies.

Today, the progress of the hydropower segment is mainly driven by the need to achieve the aims of climate and energy policies by promoting renewable energy. The Renewable Energy Source Directive (RES Directive, 2001/77/EC)

[74] DOE (2006). *Energy demands on water resources. Report to Congress on the interdependency of energy and water*. U.S. Department of Energy. Technical report.
[75] IPCC (2007). *Contribution of Working Group I to the Fourth Assessment Report of the Inter-governmental Panel on Climate Change*. Cambridge, United Kingdom, Cambridge University Press.

focus on a substantial increase in the contribution of renewable energy source to electricity production (20% less primary energy consumption by 2020, 20% less of greenhouse gases produced and 20% share of renewable in energy consumption). The most recent development in this context at European level was the acceptance of Directive 2009/28/EC on renewable energy by all EU Member States. In order to reach a 20% share of energy from renewable sources by 2020, the Directive sets ambitious goals for the Member States. The Swiss Federal Energy Act also establishes the objectives for energy production from green-sources. Consequently, most of the Alpine Countries to join fixed targets have set up exhaustive support schemes for renewable electricity production. There are well recognised reasons for increasing the share of electricity from renewable energy sources: this can improve energy security, mitigate greenhouse gas emissions next to regional and local pollutants from the power sector and it has the potential to increase the competitiveness in renewable energy technologies. For these reasons, each State set targets for renewable energy sources. With regard to EU Member States, those national overall targets are specified in Annex I of the new directive on renewable energy 2009/28/EC and have to be met by 2020 (table 3.4, column B). In order to achieve those ambitious targets, each Member State had to establish national action plans by June 30th 2010 which address inter alia the production of electricity from renewable sources. Furthermore, the Swiss Parliament has decided to increase the production of renewable energies by at least 5400 GWh by 2030 in order to stabilize or reduce CO_2 emissions as quickly as possible. For hydroelectricity the goal is to increase Swiss hydroelectricity production by at least 2'000 GWh by 2030.

3.1.2 Environmental and landscape issues related to hydropower

It is clearly evident how water and beautiful landscapes represent essential resources for the state of the environment. Certainly, their importance is strictly connected in terms of the role they can play in the overall ecological balance of a sufficiently extended area. However, as mankind knows since already several centuries, water is also a source of economic income. As

everybody knows, water, thanks to his natural flowing characteristics, may be used to produce energy. Hydropower, in the last decades, has massively benefited from it in mountain areas, in order to sustain the energy demand coming from industrial and urban areas, located even far away from the original source. Moreover, water is constantly in touch with spatial planning and with spatial organization processes. This is something that has often been forgotten.

Conservation strategies of valuable areas, in terms of landscape and environment, must necessarily be analyzed and compared to the needs of constant land transformation, in turn linked to urban, socio-economic laws and natural ones. Until now, water preservation interests have often been separated by the processes of urban planning, social and economic development. The conflicts between those who preserve and those who transform belong to the past: as a matter of fact, conservation may be guaranteed as long as it is supported by innovation[76]. The main general objective should be to ensure and let the seed of conservation in landscape penetrate all actions of change. At this purpose, ancient landscapes and environments must play new roles if they want to "survive" and not to be marginalized.

Nowadays we are facing a situation where the energy production must have an exchange with the existing situation: a smart use of resources is the real challenge which we cannot neglect and escape from.

First of all, we should not simply analyse lower impacts, but we should focus on the exchange in terms of design and planning with the existing situation. We have to find new ways so that this new energy production systems interact with all ancient sounds, natural balance which are constantly evolving and are not static and rigid, as often described.

The growing concern on energy issues and the need to reduce carbon dioxide emissions in the atmosphere show that there is no community that can be considered exempt from the task of supporting a future with low greenhouse gas emissions. However, assuming a positive approach with respect to the

[76] Sargolini M. (2010). *Interaction between different knowledges for a good landscape management*, in: Pedroli B. and Goodman T. (a cura di) *Landscape as a project*, Casa Editrice Libria, Melfi, 2010:65-68; ISBN 978-88-96067-51-2.

possible spread of alternative energy production systems does not mean to give always the green light to any types of project. In fact, sometimes, it is not possible to achieve the goals that had been previously defined. As a consequence, a balance of the wide range of issues of landscape, natural, environmental, as social and economic character, has to be carefully taken into account. Projects for the use of hydroelectric energy can give an important contribution to sustainable development, when the settlement easily integrates into the landscape and the area in which takes its place.

The action of transforming a place, which can be represented by the construction of a plant for the production of hydropower, therefore requires an appropriate interpretation of the designated area for planning the construction. This is specifically true for an area, like the Alpine one, where natural resources are intimately linked with cultural ones. The objective to reduce as more as possible the extent of any possible impact on the landscape should not exclude or ignore the analysis of exchanges in terms of design and planning related to the existing situation. As a matter of fact, it is commonly believed that the only possible solution is the one provided by engineers, technicians and experts; in reality a multi perspective point of view is more desirable, thanks to the integration of an interdisciplinary approach which include various set of skills and knowledge (economists, geologists, geographers, environmental experts etc.).

In fact, the contribution of several experts coming from different fields of study have surely the merit to improve the evaluation and the focus of potential issues and problems which may be encountered.

The design of a hydroelectric power station does not have only one (certainly indisputable) relevance from the technical and engineering point of view, but it also requires a deep evaluation of the landscape (including, of course, environmental considerations). A lot of recent examples, such as the Winter Olympics in Salt Lake City (2002), San Rossore hyppodrome, wind farms in Tuscany, ANAS project of strengthening or doubling of A14 highway along the Adriatic coast, or extraction areas in the Regional Park of the Alpi Apuane demonstrate the importance to consider a similar approach.

Summarizing, minimizing the impact of a plant on the landscape and on the environment (as the law already requires in the field)is not enough, whereas it

becomes essential to analyze the work as part of the Alpine landscape in which it appears, favoring the integration of the water element and the built infrastructure with the existing ecological context.

3.2 Economic aspects of the hydropower use in the Alpine area

3.2.1 Environmental and economic costs and benefits

The WFD recognises an important role to the economic evaluations in the definition of the measures of the River Basin Management Plans. Particularly, it requires that both the environmental costs and the cost of the resources used to supply water services (among which also the hydroelectric power generation one) are quantified and "internalized". Although there have been some attempts to quantify the externalities of the hydroelectric production, the actual concession charge (and all the extra charges) does not have any connection with the environmental impact of the hydroelectric systems on the territory. Besides, an economic evaluation should not ignore the estimation of the income from hydroelectric power generation, that is actually linked to the exclusive use of a scarce resource (De Carli, 2010) [77].

The economic analysis of the energy production sector is based on the yield or *rent* concept. In (micro)economics, a rent is represented by the (positive) quantity of money originating as a mathematical difference between the marginal income deriving from and the marginal cost of supplying an extra unit of product or service. A rent is always present in a monopoly condition, that is when a certain good or service is provided by a single subject over a relevant market. If a monopolistic market is compared to a free market, the rent existing in the former can be seen as an excess in the distribution of a factor in a production process above the minimum amount required to draw the factor into the process or to sustain the current use of the factor.

In the presence of a scarce resource and of a single subject allowed to use or

[77] De Carli, A. (2010). *Environmental and economic costs and benefits of the hydropower use in the Alpine environment.* Third Alpine Water Conference, Preliminary Workshop n.3, Sondrio, Italy, 26th October 2010.

distribute this resource on the market (exclusive use), an economic rent is observed as a consequence of the scarcity itself.

In the field of water services the condition of a “natural monopoly” is recognised, depending on the limited amount of a resource that is actually available and e.g. by the high fixed costs borne to construct the infrastructures needed to deliver water services (which require relevant investments, as it is the case with the water distribution networks). In this case, a monopolistic management of a service reveals the economic savings (scale economies) which descend from a unitary management of the supplied services. Also legal regulations recognise the nature of these services and tend to create monopolistic, semi-monopolistic, or oligopolistic markets, e.g. by issuing exclusive concessions for the use of a scarce resource such as water, when the specific market conditions recalled above are recognised.

When considering hydropower production under an economic point of view, it is necessary to keep in mind a few characteristics of this market.

First, hydropower industry is characterised by a marginal cost of production (per kWh) lower than other modes of energy production. Thus, the price of energy is determined on the electric stock exchange, where the actors incur in higher marginal production costs (due to other more expensive technologies available to produce energy) resulting in a high “energy market price”.

Second, the cost structure of a typical hydropower plant is largely composed by a fixed cost share and, to a much lower extent, by variable costs. Moreover, especially for larger and older plants, fixed and setting up costs already have been amortized for the most remarkable share. This implies that the “fixed part” of the cost function tends to decrease the more kWhs are produced by a given hydropower plant: thus there is an incentive for the sector to increase the quantity of energy supplied.

Third, the overall quantity of energy that can be produced from hydropower is limited, due to the relative scarcity of water that can be used to that aim. This fact determines the need to make use of other, more expensive sources of energy in order to meet the whole energy demand, with a resulting increase in the energy price – attracting competitors in the sub-markets where there is a greater spread between the cost of energy production and the actual market price of energy (as it is the case with the hydropower market).

Fourth, economic incentives are widely adopted in the sector, especially with regard to the renewable energy production that is prized through the payment of a fixed sum for each marginal unit of (renewable) energy supplied (measured in kWh) – the so-called "Green Certificates Scheme". These payments are set up in order to increase the quantity of renewable energy supplied on the energy market, and they incentivize energy suppliers (hydropower plants included) to produce as much (renewable) power as possible.

As a consequence, the hydropower sector is very profitable, if compared to other sources of power production (Bano & Lorenzoni, 2008)[78], due to the applied technologies, the peculiar structure of its cost function and the long history of the sector, dating back to the end of XIX century (e.g. in the Italian Alps). Moreover it also profits of a further, vital support represented by the Green Certificates.

Though, it is important to notice that not all the plants share the same characteristics and particularly that two main types of plants exist:

- the *diversion hydropower plants* can exploit scale economies, generally have already amortized the investment (lower fixed and marginal production costs), currently have to bear only costs for the extraordinary maintenance (repowering; loads removing; hydro peaking), and can decide to concentrate the energy production during the peak hours, when the energy market price is higher, due to the higher demand from the users.
- The *through-flow hydropower plants* have smaller outputs, on average and marginally, they have to produce energy continuously (they cannot adjust the production flow according to the variations of the energy demand) and have management costs meaningfully depending upon the height of the waterfall and the productive capacity of the plant. Their cost function relies on the cost of capital, depending on the level of amortization of the investment, whose dimension in turn depends on the morphology of the site (height of the waterfall, typology of construction works, need for restoration interventions). Moreover, the discounting rate applied to the investment is crucial to determine the cost of the investment itself.

For both the plant types , the costs are mainly fixed, therefore the average cost

[78] Bano L. & Lorenzoni A. *I costi della generazione elettrica da fonti rinnovabili*. Economia delle fonti di energia e dell'ambiente, 3/08 (in corso di pubblicazione).

for kWh depends on the productivity of the plant (i.e. on the supplied kWh), and therefore from the usable water flow compared to the investment, the rent depends on the oscillations of the market prices of energy and green certificates. Finally, the small to medium plants can be profitably used for self-production and consumption, since in this case the economic benefits would derive from the savings achievable in comparison to buying alternative sources of provision at market prices.

One simplified evaluation of the rent achievable in the hydroelectric sector (Massarutto, 2010)[79], developed making use of the estimates of the sector costs and revenues (Bano & Lorenzoni, 2008; and De Paoli, 2008), has allowed to calculate the economic rent of the hydroelectric sector, diversified according to the class of production (small and larger plants). As shown in the following table, the economic rent grows while growing the power class, among 46 €/MWh of the plants with power up to 1 MW and 84 €/MWh of the greater plants (table 3.5). The table also shows how the release of Green Certificates distorts the market: in absence of them, the economic result becomes negative.

Table 3.5 - Calculation of the economic rent of the hydroelectric sector, diversified according to the class of production. Values in €/MWh (2008) (Massarutto, A. 2010)

Power	**> 10 MW**	**1-10 MW**	**< 1 MW**
Revenue	180	180	220
Energy National unitary price	75	75	75
certificates FER	105	105	145
Total costs	96	106	174
Operational costs	21	17	104
Capital costs	76	89	70
Profit	84	74	46
Profit without FER	-21	-31	-99

[79] Massarutto, A. (2010). *Economic assessment on the hydropower use in alpine environment.* Third Alpine Water Conference, Venezia, Italy, 25th-26th November 2010.

Although subject to some simplification, due to the standard costs not always corresponding to the real costs of production (there is an high variability in both the investment and the operational costs, and the installations revenue is linked to the water flows and hydrological factors) and to the fact that market values are fluctuating (there is a strong influence of the market in the electricity price, the value of Green Certificates is decreasing and does not cover the whole installations' life, there is a risk to see changes in the current legal framework in the years to come) the results of the study show a trend for the hydropower producers' income.

Moving to a wider territorial context, the same cost scheme has been applied to the Piemonte Region (Massarutto, 2010), with the results reported in the following Table 3.6. The reported figures aim to provide a rough assessment of the dimension and economic relevance of the hydropower rent collected over the territory considered.

Table 3.6 - Figures on hydropower production in Regione Piemonte (I) (€/MWh, in 2008) (Massarutto, A. 2010)

Potentiality	MW	> 10 MW	1-10 MW	< 1 MW	Total
N° of plants		25	147	750	922
Power	Total MW	476	418	131	1.025
Total production	GWh/year	778	938	542	2.258
Total yield	k€	65.196	69.693	24.824	159.713

In Italy, there is a strong fragmentation on the concession tariffs and fees paid by the hydropower producers. According to the same estimate made for the Piemonte Region, the total amount paid by hydropower producers covers 25% of the gross economic rent of the sector, which is an economic concept differing from the profit, interpreted as a remuneration of the investment[80], and it can be attributed to the use of a scarce resource.

A further specification on the concept of *economic rent* can be of some use. The

[80] Calculated as “weighted average cost of capital” (WACC), that is a sum weighted on normal profit, risk and entrepreneurial initiative prize, according to the principles of corporate finance.

mere existence of a rent (even a high one, as it is the case for hydropower production) is not unfair *per se*. Recognising its existence pertains to the domain of positive economics. The normative economic (and political) question is how to allocate it.

It is thus important to decide if the yield should go to the producer in the form of *extra* profit, or if it should be transferred to the community, and in particular:

- to the local community through the transfer of shares of the income in the form of taxes, canons, or compensatory actions;
- to the general community through taxes and canons;
- to the local consumers as a discount on the market price of energy.

Another action, affecting a different interest of the community, and now requested by the EU law, consists of returning the rent in terms of quality of the water bodies over a certain territory. This can be made in the form of retaining/ remediation/ mitigation measures, as asked by the WFD in order to achieve a "good ecological" status of a water body.

In order to allocate in the correct way the economic rent of hydropower production it is necessary to consider both the economic and social costs of hydropower, thus considering the opportunity-cost of the resources employed in the process and the potential harm of this production process on the environment and the society at the water body scale. The full value of a resource is unlikely to be recognised, as long as the users and polluters of that resource are not called to pay for the use or compensate the harm to the resource itself.

In order to introduce this particular cost category, including the environmental and social costs, it is essential to briefly refer to the fundamental economic concept of "externality". An "externality" is a cost (or benefit) that is not transmitted through the mechanism of prices, nor traded on a market. It is classically incurred in by a party who does not take part in the action which is producing the cost (or benefit) to happen: for example, a power plant that causes hydropeaking imposes a cost on the whole society – even though the society at large is not given the possibility to discourage (e.g. through compensatory payments) the power plant from causing hydropeaking. As recalled above, generally there is no market where externalities can be traded:

as a result positive externalities (benefits) tend to be over supplied and negative ones (costs) under supplied, with a lowering of the overall social well-being of the affected community. On the other hand, private goods are traded on a market and supplied in a quantity that is consistent with the market demand for them. Private cost of production includes for instance job cost and capital cost, while the social cost (benefit) of production should also include the value of the negative (positive) externalities, which has to be estimated and expressed by means of a monetary unit. Often the transfers from the producer to a public authority in the case of hydropower generation (e.g. canons of derivation) include only private costs, and ignore the related social costs. A greater recognition of the externalities produced by hydropower (and other water uses) in the price of energy paid by users and canons paid by producers is demanded by the EU Regulation (e.g. WFD).

Hydropower generates both positive and negative externalities.

Positive externalities (benefits) of hydropower include “green” energy generation (compensated by the green certificates), distributed generation network reducing leakages from the power grid, self consumption. Negative externalities (costs) of hydropower include the reduction of the ecological function of the stretches underneath, and the loss of recreational and landscape values.

These negative externalities might be theoretically compensated by environmental taxes and fees (canons, etc.). Nevertheless, neither the green certificates, nor the canons in Italy are calculated accounting for the value of the externalities. Thus the concessions and the related cannons are not linked to the external costs or benefits generated by the activity under concession on the environment, as it is instead clearly asked by the WFD. It is thus necessary to redefine these tools re-orienting them in the direction of collecting a a higher fee from those plants that generate greater impacts, and grant incentives or tax relieves to those that adopt eco-friendly or less impacting technologies.

The key is to reconsider the economic value of green certificates and fees in order to take social costs and benefits into account. Green certificates should recognise and reward the social benefit of exploiting renewable sources, although at present the value of green certificates is based on their market

value, which in turn depends on the number of renewable energy plants on the territory where certificates are traded. As a consequence, the value of green certificates depends on the national threshold of renewable energy determined by the law (at the national or sub-national level in Italy), and not on the value of the renewable sources in terms of delivered social benefits. The same applies to fees, that are still based on the rules defined by law in 1943 in Italy and their value depends only on the installed power.

According to the WFD, the economic decisions in the field of water management have to:

- base on the principle of ecological, economic and social sustainability,
- endorse the consideration of costs/benefits and costs/effectiveness ratios,
- avoid disproportionate costs and
- apply the principle according to which the ecological integrity of a water body is a “not negotiable objective” but in exceptional cases.

With reference to costs' recovery the WFD clearly indicates that the costs have to be attributed to the polluter and that the “polluter pays principle" is to be applied. Costs have to be determined applying the framework of an integrated management of the resource, emphasizing the "collective" nature of both the resource and its management system. The external costs and costs of shortage (or rather the yield) should be included in the full cost function.

Moreover, a possible conflict emerges regarding hydropower development. WFD stresses the need to protect and recover the damaged environment, RES Directive (2001/77/EC, now replaced by 2009/28/EC) instead is aimed at increasing the share of energy production from renewable sources.

Concerning the environmental impacts that may derive from hydropower production, some open questions regard in particular the need to understand which is the maximum level of deterioration bearable by a water body, that is how much income is it possible to extract from a renewable resource without seriously deteriorating it.

Renewing the concessions on existing hydropower plants, releasing new ones and identifying clear criteria to ground the release of new concessions upon represent a primary challenge on the policy side. The responsibility of the

public sector on the release or renewal of plants' concessions should ensure that any decision in this sense is compliant with the principle of assuring the general interest of the territory and the community, that is made up of both private and public stakeholders, bearing their own interests, which are to be taken into account when addressing the above mentioned principle. This is even more the case when the public sector not only plays as a regulator but also is the regulated entity, because of the direct ownership and management of some plants. In particular, when publicly owned companies are taxed, the collected revenues are destined to the local government (which also participate in managing the companies themselves), thus they can be seen as a “money transfer” happening within a single system. On the contrary, when private companies are taxed instead, the collected revenues represent for them purely a cost, since the resources are used by a different entity than themselves, for different ends; thus the competition is likely to be misled between public and private companies. According to some, the hydroelectric exploitation of water resources has already expressed a remarkable contribution to the development of renewable energy in several Alpine regions. Then, a further exploitation from hydro power can still provide benefits to the producer (especially in the case of small hydro power plants this happens to some extent thanks to the public subsidies granted), though, the collective benefit seems to be on a decreasing trend, according to the evidence of a series of negative consequences for other public policies and water quality aspects. Nevertheless, it is central recognising that the exploitation of water resources for electric power production could still be important for local development in some mountain areas.

Still, recent research performed on the Alpine territory suggests that if some reasonable criteria are followed, a sustainable, profitable and less impacting hydropower production is likely to be achieved. Some remarks, coherent with recent achievements in applied research experiences, are suggested here below.

The planning of the resource exploitation should be organised on the basis of an integrated view of the whole river basin and not according to a "case-by-case" logic inside the basin. Moreover, some common criteria should be selected to determine both the maximum level of exploitation of the water resource available at the basin (or sub-basin) level and which uses of water are to be preferred within the basin (sub-basin) itself.

The delicate issue of the dimension and earmarking of the economic rent deriving from the use of a scarce resource (as water is) has to be carefully analysed, especially with reference to the distributional options for the rent itself and their effects. The priority to be given to some out of more subjects competing for the use of a limited amount of water within a basin (sub-basin) should also be planned in line with consistent, transparent and steady criteria.

Incentives should be recognised and granted to virtuous users when the resource is exploited in an eco-friendly manner. This means not only looking at (and prizing) the capacity of water users to ensure the residual flow of a water body, but also supporting river restoration measures and active initiatives for the conservation and enhancement of rivers and their environmental features (as suggested for example by the CH_2OICE Project). Canons and other economic instruments can be used to price or economically assess the differing capacity of operations affecting a water body to harm or support the ecosystem services within a river basin (e.g. restoration effects, or reduction in MDV): for instance, environmentally-friendly initiatives can be compensated and harms discouraged according to the environmental benefit or cost they produce. The management of water resources can be improved by enacting a set of measures directed to internalise the external costs of exploitation so that they are taken into account in the process of resource pricing; wider social benefits can also derive from a coherent sharing of the economic rent collected from the public concessions released for the use of the resource and the trade of energy, that should be consistent with an "equity principle". In this line, the River Contracts can prove to be an appropriate institutional tool for defining, through a participated process, a set of provisions regulating the management of water and how costs and benefits are to be shared.

Within the hydropower natural monopoly, competition among subjects happens *for* the market (not *in* the market) when new concessions are granted or existing ones renewed. Therefore, the process is fully managed by public authorities which are aware of the existence of the economic rent deriving from the exploitation of the resource and the possible role of "compensation" that this money (or a part of it) can play for the undesirable social and environmental consequences of hydropower production[81]. A possible use of

[81] The public authorities releasing a concession for hydropower production can also set up some

the economic resources collected from the release of concessions could address the recovery of those river stretches that are not in a "good status" (CH2OICE Project).The existence of a "hydroelectric rent" is also well known by the companies competing for a concession's grant, that are likely to contend the use of jump for hydropower production and are ready to offer a part of the rent to the releasing authority in order to get the concession.

On the other hand the *"de facto"* situation has to be recognised. Not all investments made by hydropower producers for their plants have already been amortised – a issue that need to be addressed and considered once concessions have to be renewed; and serious conflicts due to equity, transparency and efficiency considerations may arise when a public body both releases a concession as well as managing the deriving production process or service.

The peculiar characteristics of this sector make possible (e.g. through an adequate use and sharing of the rent) for the society to address environmental and social aspects of hydropower production. Though, this requires that clear choices are made and shared among the most relevant stakeholders being present on the affected territory, asking for both economic prosperity and environmental quality of their territory. Participatory processes, such as the river contracts and others, may help improve the direct involvement of the local population both in the developing and management of new planning instruments and in the definition of decisions about the use of economic returns. This process cannot be seen as being independent from the overarching environmental legal framework (represented by acts as the WFD) asking for a sound environmental management of river basins and for a recognition of the primacy of the ecological status of water bodies.

Examples in Europe

In England and Wales the derivation/unloading canons are calculated as a function of the number of collecting/unloading points, their environmental impact on the water body and they are earmarked to financing the

conditions in the contract, according to which the concessionary bears the obligation to perform specific actions, e.g. to compensate or limit the negative effects of its operations on the environment, the river basin or the surrounding land.

Environment Agency.

In Germany and Denmark the canons of derivation and unloading are very elevated (up to 1 €c/m^3) and are destined to the public (Länder) budget. Often compensation tools and measures for ecosystem services are framed within bilateral contractual schemes. Moreover, a wide use of the instrument of a mandatory consortium of users is found for a number of different aims.

In France canons of derivation and unloading are arranged with the Waters Parliament (in every hydrological basin), their destination is to finance the water policies within the same basin.

Theoretically three possible strategies exist on how to release new concessions in the presence of a scarce resource, in a context where priorities have changed over the time:

- open the market to incumbents and, by means of legally binding instruments, introduce limitations and conditions when new scientific knowledge or options and priorities concerning water use and its consequences come to existence. Such a strategy is not feasible when externalities deriving from hydropower and water usage are not duly embedded in the system
- close the market to the actors (or the number of actors) who already operate in it, by setting up a threshold to the usable quantity of water for hydropower production and limit the number of concessions to be released. This strategy is likely to stop the release of new concessions, is drastic and effective, but iniquitous;
- set a limit to the overall exploitation of the resource by redistributing the benefits from hydropower production also to the subjects that cannot receive new concessions.

The third strategy may seem hardly feasible as a policy, but it is equitable. Moreover it weighs the acquired rights, but also recognises the need to protect the legitimate expectations of the investors. Thus, this is likely to be the road to follow, even though concrete actions have to be taken to manage and respond to the pressure exerted by the holders of rights (concessions), that generally want to maintain the *status quo*.

Still, some open and generally delicate questions remain that should be tackled in order to deliver a sustainable, correct and equitable management of the

hydropower sector.

The role of the public decision maker should be neutral and independent from the different interests involved in order to assure the transparency of the process. This is not the case when the decision maker directly take part in the game, as it happens with utilities companies that are publicly owned. The public sector should play a role of referee and defend the dominant public objective inherent in the management of a scarce environmental resource, when confronted with the other involved actors (businesses, organisations, citizens' groups, etc.).

The nature of public asset of water does not imply absolute freedom in the use of the resource. Moreover, the existence of a rent associated with hydropower generation does not mean that it is unlimited. Being partially absorbed by the price of concessions and other possible fees, the rent has not to be considered so huge that all stakeholders can ask for compensation or extreme mitigation practices. The main aim of a wise management of water is to achieve sustainability in its use, not to turn the legitimate economic use of a public good into a crime. A proper management should aim at reducing negative and enhancing positive externalities connected to the use of an environmental asset.

An accurate quantification of the economic rent of hydropower would help set the most appropriate fees and concessions' prices for water users, that should vary over time consistently with the rent's trend (e.g. depending on the performance and volatility of the energy prices on the electricity market, on the government incentives for renewable energy, etc.)

Also, releasing new concessions for the use of water appears as a relatively easy procedure to collect fees from the new beneficiaries. Nevertheless, it is important to remember that it is legally much more complex to intervene on the concessions once they have been sold – moreover, such an attitude is likely to create an undesirable climate of uncertainty of the right of use.

However, the need to foster energy production from renewable sources to comply with the obligations set by the European directives (2001/77/EC, now replaced by 2009/28/EC) has implied a considerable increase in government incentives. This has led to dramatic changes in the cost-effectiveness of hydropower and other energy productions: projects that until a few years ago

would not even be taken into consideration can now pay back. Concretely, this translated into an extremely high number of applications for concessions for new hydroelectric power plants, especially of small size, that would be added to the already high number of existing facilities. The features of water as a limited asset, associated with some typical traits of the industry and with other local and environmental aspects, however, make the full exploitation of the available resource for the production of energy not sustainable. Several reasons have been recalled for this lack of sustainability including conflicts in the use of water resources, the environmental impact of the hydroelectric use of water, the impact of energy production and of the construction of hydroelectric power plants on the landscape, the established presence of large plants and artificial basins covering the nearly total availability of large water diversions, the desirability to diversify investments and the local economy in mountain areas where hydroelectric power plants are located.

Recently, a growing interest has been observed among Alpine populations and local governments to limit the further exploitation of waters, and look after the quality of the alpine environment and landscape, while receiving a greater share of the economic yield of the hydroelectric industry with more economic benefits for local areas and governments, similarly to that which already happens in some Alpine areas in Italy (Autonomous Provinces of Trento and Bolzano). In Italy, these demands have generated law-making initiatives such as the approval of article 15 of law 122 dated 30 July 2010, which gives the Provincial Authorities the opportunity to directly take part in the management of the power plants, as well as set up an immediate increase in fees. The very scope of these law-making initiatives has not yet been fully understood. While it is generally accepted that fees can be a significant tool for the management of the creation and allocation of yield, for example by differentiating them on the basis of the effects of the action on the watercourse, or by establishing mechanisms to remunerate those who take steps to recover/improve the ecosystem functions of the water course, this policy casts serious doubts about the opportunity of the penetration of the public sector in the industries which it regulates, especially with respect to plant concessions and management. The controlling body and the controlled entity should in fact be distinct organisations with distinct roles.

3.2.2 Corporate Social Responsibility (CSR) in the hydroelectric sector [82]

Hydropower production in the Alps represents a solid industrial sector since more than a century ago. Historically, water is the mountain renewable resource most exploited for energy production (RSA2, 2009).

The physical characteristics of the mountain environment, coupled with some typical features of the industrial sector of reference and with other territorial and environmental aspects, still make a full exploitation of the available resource for energy production unsustainable for different reasons (as explained also by the Water Framework Directive), including:

1) the regional and local conflicts arising among the different possible uses of the water resource;

2) the ecological impact of hydroelectric use of water and its costs[83];

3) the impacts of hydropower production and of the hydroelectric plants on the mountain landscape (and their related environmental, social and other costs that may be linked to the need of compensatory measures);

4) the well-established presence of big plants and large reservoirs, covering the almost total availability of greater derivations;

5) the desirability of a diversification of investments and of the economy in

[82] Cetara, L. (2010). *Hydropower, territory, community: lessons and perspectives in the corporate social responsibility's context.* Third Alpine Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

[83] The most prominent phenomena regarding alterations of the flow regime in Alpine regions are: a) too little residual water in rivers, as a consequence of which minimum standards for the "ecological flow" in river stretches are not achieved due to water abstraction, and b) "*hydro-peaking*" caused by a sudden discharge of water. Considerations on water quantity and quality (also in terms of temperature, etc.) can make highly desirable actions aimed at restoring and maintaining ecological conditions in the aquatic environment. Mitigation measures are often accompanied by considerable changes in the management practices of hydropower stations or by related expenses for the construction of retention reservoirs. Hydro-peaking, in particular, is considered to be a pressure to be tackled in a step-by-step approach in order to reduce the impacts on ecology and to fulfill the requirements of the environmental legislation in the coming years. Sometimes a proper integral water management can ensure positive economic and ecological outcomes, as it is the case for Bavaria, where flood control for the villages, nature conservation and a balanced river morphology as well as the generation of renewable energy from hydropower have been achieved. Though, it is not always possible to reconcile these interests without conflict. Intense discussions between all parties involved are required in order to reach viable solutions and find a compromise.

mountain areas already hosting hydroelectric plants (e.g. Sondrio area, where big plant are located);
6) the massive presence in EU national markets of public subsidies for renewable energy production which alter the energy market conditions and the economic/financial sustainability of investments, at least in the short run (e.g. Green Certificates) (REN21, 2011);
7) diminishing marginal returns of water use for hydroelectric aims for companies already owning big installations and beneficiaries of important derivations.
Public territorial administrations, companies and the civil society are largely conscious of the situation summarized above. Each of these compartments tend to focus on different topics, but the assertion that, on the whole, the combination of the interests of the three major stakeholders groups recalled above (i.e. business, public authorities, civil society) covers the majority of these issues can be considered reasonably credible.
Proper scientific knowledge from research institutions adds to the list of the components generally considered necessary for the policy maker to decide. The completion of informed choices preliminary to the selection of policies grounded on this type of knowledge, is thus eased in this case.
Proceeding separately for each involved category of subjects, public administrations (PAs) are given the responsibility of the assumption of political choices. In this activity, they are bound (but to some extent also facilitated) by the existence of high level technical EU legislation (for example WFD) and, often, also of superior administrative rules. Administrations, being entrusted with the task to implement public policies, are called upon to interpret the political demand expressed by the civil society through the vote and other forms of political participation to collective choices. Such a participation can also be more direct, open and built on a voluntary basis, as it was the case with public hearings and workshops organized in the Province of Sondrio to set up the Province's Landscape Plan. Political institutions thus have the task to maximize and implement, through sectoral policies and measures, the “social well-being function”, that results from the information conveyed by citizens when taking part in the political life and that the PA is called upon to pursue. Doing that, PAs primarily have to ensure the application of the (usually vague) concept of “sustainable development” in their own policies and search for a

balance between competing territorial interests: two aspects that are also incorporated in the WFD principles.

Companies that manage hydropower plants can for the majority be included in the category of large corporations, and they often are multinational enterprises. Generally these companies increasingly invest in Corporate Social Responsibility (CSR): the “utilities” sector represents a major reporter (GRI Reporting Statistics for 2010 are available on line on the GRI website).

CSR has been defined as a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis (CE COM, 2006; IOE, 2003). CSR is known as a developing concept that proceeds by stages, setting for the enterprise not strictly economic goals , and generally generating win-win situations (OECD, 2001a, OECD 2001b). In particular the companies that operate in the Alpine area are among the main subjects in the promotion of sustainability practices at national and international level (for example, for ENEL, see the data for 2010 in the framework of the Global Reporting Initiative (GRI), its sustainability policy and reporting practice) and directly participate in programmes aimed at the definition of voluntary standards for sustainability reporting (for instance, the GRI).

Not only sustainability measurement is a demanding macroeconomic issue (see: Stiglitz, 2009), but it is also a central challenge also at the individual business level, where alternative measures of a company's performance with reference to the domain of sustainability – ranging from large dashboards to single, all encompassing indices – have been proposed and applied (see: Labuschagne et al., 2004; EEA, 2005; EUROSTAT, 2009). A widely accepted practice within the business community has become to develop standard sets of indicators on a voluntary basis, that combine advantages as freedom in use, shared construction costs, comparability over time and between organizations, continuous update based on international working groups, novelty, sector-specificity (Boulanger, 2008; see also the GRI experience and its website).

Among the sustainable development indicators adopted as a voluntary international standard for organisations eager to measure their sustainability performance, we will briefly consider here the case of the Global Reporting Initiative (described in details at: www.globalreporting.com). The GRI Reporting Framework sets out the “Principles” and “Performance Indicators” that

organizations can use to measure and report their economic, environmental, and social performance. Within this framework, a set of indicators is usually applied in the sector of (hydro) power production and utilities. They are not only environmental indicators, as they also consider other fields of analysis (society, work, relations with consumers). A growth of the company performance according to this developmental perspective (in line with the broader principles of CSR policy) seems to be coherent, at least broadly, with some of the objectives pursued by other two main stakeholders groups present in the Alpine territory: the PAs and the civil society.

It is noticeable that sustainability reporting has been constantly growing since 1999 and a substantial rise has been registered along the last few years (+22% between 2009 and 2010). Recent reporting practice has been recognizing also the value of different approaches (and indicators) for each sector, which reflects at the global level in the figure of the majority of reports produced for electric utilities according to GRI standards developed using the sector supplements (according to GRI statistics for 2010).

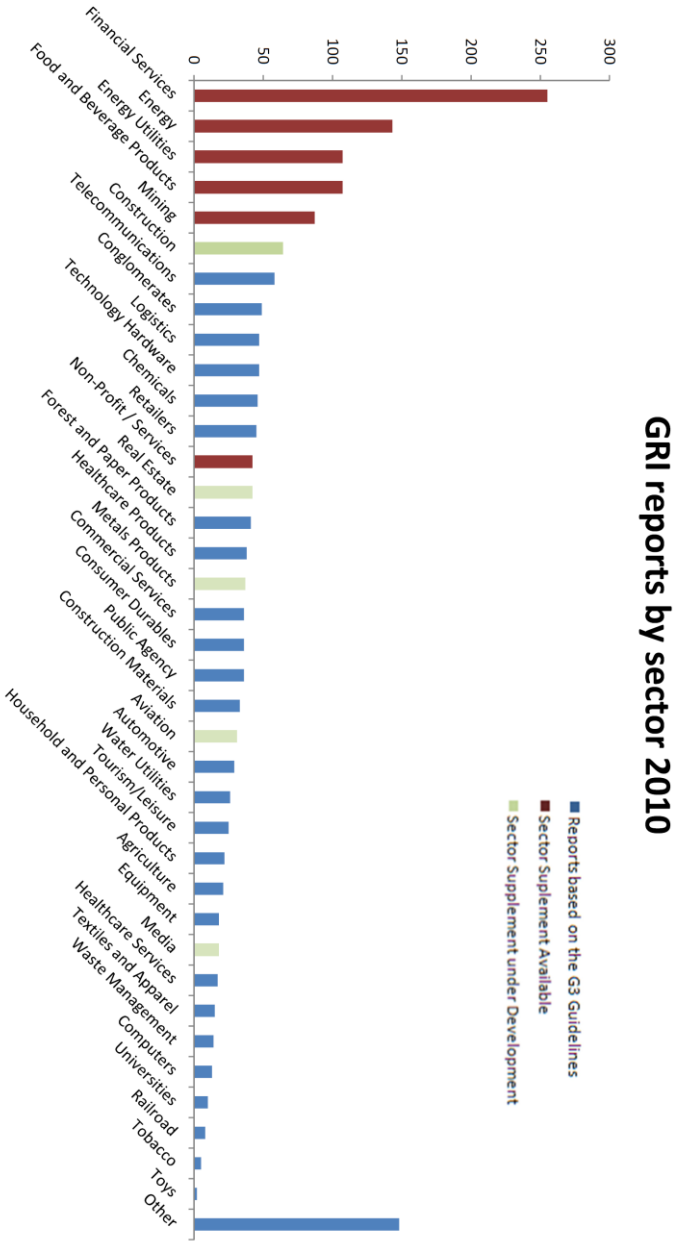


Figure 3.10 - Number of issued reports according to GRI Guidelines, by sector, for 2010 (Data: GRI 2011)[84]

[84] http://www.globalreporting.org/NR/rdonlyres/954C01F1-9439-468F-B8C2-B85F67560FA1/0/GRIReportingStats.pdf

In the table that follows we provide only a sample of the indicators suggested for the energy & utilities sector that seem to be consistent with the features of hydropower in the Alps. They essentially come from the GRI Guidelines and Sector Supplements.

Table 3.7 - Selected Performance Indicators for Reporting in the "utilities" sector (Cetara, L. 2010)

Environment Performance Indicators	Human Rights Performance Indicators	Labour Practices and Decent Work Performance indicators	Product Responsibility Performance Indicators	Society Performance Indicators
Materials (weight, voll., recycled %, etc.) *Energy*: (Energy sources; savings; use of renewable energies; etc.). *Water*: (extracted water;voll. of recycled/ reused water) *Biodiversity*: (lands owned near protected areas; main impacts; compensatory initiatives; IUCN indicators) *Emissions, effluents, waste* (GHG; mitigation efforts; other emissions air & water; waste; *Products & services*	*Investments and Procurement Practices: (HR clauses in commercial agreements,* training & education on the matter, etc.) *Non-discrimination* (# of cases, etc.) *Freedom of association and collective bargaining* (check) *Security practices* (training, staff trained, etc.)	*Employment*: (quality of workforce, health and safety requirements; workforce for job type, contract, region, etc.) *Labour/management relations* (collective agreements; timing of communications on relevant change in operations; etc.) *Occupational Health and safety*: (% accidents, diseases, lost workdays, deaths; education, initiatives for assisting workers and their families; relations with unions, etc.) *Training and education* (annual education for worker; programmes for long life learning; development, career and performance reviews carried out; etc.)	*Access* (programmes also with governments to assure energy access to consumers; % of not supplied population; disconnection rates; average duration of interruption in energy supply; regulatory issues; etc.) *Provision of information* (practices to overcome barriers for a safe use of Energy and appropriate customer support services) *Customer health and safety* (life-cycle-assessment of service impact on health and safety; risks;	*Community: (*participation of stakeholders in energy planning and infrastructure development; approach on the management of the location impact; results of programmes in terms of impacts of operations on the community; etc.) *Disaster/Emergency planning and response* (planning measures, management plans of disasters and training; restoration plans; etc.). *Corruption*: (corruption risk analysis) *Public Policy* (participation in public policy

(mitigation initiatives, packaging, etc.) *Compliance* (fines and sanctions for environmental damage, etc.) *Transport* (environmental impact, delivery management, etc.). *Overall*: (total expenditure for environmental conservation, etc.)		*Diversity and Equal Opportunity* (composition of governing bodies and workers categories by age, gender, minorities, etc.; minimum wages ratio; etc.).	legal actions; diseases; accidents for noncompliance with voluntary codes; etc.) *Product and service labeling*: (information requirements and type for each product; lack in labeling practices; customer satisfaction surveys) *Marketing Communications (*compliance with laws/ standards on marketing, communication, sponsorships, etc) *Customer Privacy* (measures and statistics on violations) *Compliance* (monetary value of relevant sanctions on noncompliance with rules on supply and use of products and services)	development; lobbying; financial aid to political parties and institutions) *Anti-competitive behaviour* (# of legal actions on anti-trust behaviour, etc.). *Compliance*: (monetary value of relevant sanctions on noncompliance with rules or regulations; etc.)

A concrete possibility for companies is the participation in voluntary environmental agreements with public authorities and institutions (e.g. regional governments, Ministries, municipalities, etc.).

The advantages that can be pursued by companies through the conclusion of voluntary environmental agreements with governments and other territorial

actors (Croci, 2008) are well-known and have been investigated by international studies. According to OECD, the benefits of these initiatives for firms include: “improved legal compliance, management of litigation risks, brand and reputation enhancement and smoother relations with shareholders and with society”. Sometimes serious commitment by firms has given industries the possibility “to deflect calls for formal regulation” (OECD, 2001c). Using a well-established and standardized reporting framework helps demonstrate organizational commitment to sustainable development, to compare organizational performance over time, and to measure organizational performance with respect to laws, norms, standards and voluntary initiatives. Good examples of guidelines have been provided by the Global Reporting Initiative (GRI: see website) and the OECD (OECD, 2004; OECD, 2005 and, more recently: OECD, 2011). Beneficial effects can be declined also with reference to hydropower sector.

At the same time, governments could identify some advantages in partnerships with privates, which tend to grow consistently with the phenomena of extended globalization and economic-financial crisis (Utting & Marques, 2010) and in particular in the context of sectors whose economic weight on the territory is considerable, as it is the case with hydropower (RSA2, 2009). In general, these agreements are pursued in order to achieve “win-win” type solutions, where different benefits go both to public authorities and private companies coming to an agreement. Public administrations can find a support to their policy making effort inasmuch as CSR initiatives “reflect business sector attempts to translate external pressures for corporate responsibility (law, regulation, public opinion) (…) into concrete business practice” (OECD, 2001c).

‚According to predominant positions in economic theory and political philosophy, in the presence of pre-existing agreements the pursuit of justice and of the enlargement of participation require to extend the participation in an existing agreement also to subjects that were previously excluded from further phases of negotiation and conclusion (Sen, 2009), but that can carry a significant contribution to the agreement’s success, by increasing its effectiveness, efficiency and beneficial outcomes. The overlapping of typical political aims (summarised in the goal to enhance social well-being or the quality of life within a society), economic ones (e.g. fostering economic development), and social aspects (quality of life, social relations & social

capital, possibility of choice) with those innovative ones of companies committed to the implementation of the CSR paradigm (Marrewijk, 2003) makes therefore desirable the search for large, voluntary, multilateral agreements, where also companies that manage hydroelectric services participate. Such an approach is expected to promote a sustainable and participatory development of the territory, starting from the often strong commitment of firms operating in the sector of hydro power production, to CSR and sustainability principles[85].

3.3 Planning strategies for the sustainable and balanced use of hydropower

3.3.1 PTCP Sondrio [86]

The Sondrio province is very important in the regional energy system: 50% of hydropower in Lombardia (Lombardy) is produced in the province of Sondrio. In terms of the Italian production this is the 2nd hydropower district at provincial administrative level, following Bolzano. Another significant index is the nominal power per inhabitant, which ranks the Sondrio province as 1st in the Country.

The territory of the Province of Sondrio is characterized by a very high water exploitation rate, due to the presence of a large number of hydropower plants. The risk to deteriorate the water bodies quality and the protests perpetrated by the population for a long time period induced the local Authorities to implement a new legal instrument to better regulate the authorizations for water uses.

Because the Plan represents the first Italian example of application of the 2000/60/EC principles at local scale, an ad-hoc working group was constituted with all the authorities involved into the concessions grant process (participants included: Ministry for the Environment, Po river basin Authority, Lombardia Region, Province of Sondrio and APAT). All the authorities shared the procedure

[85] Cetara, L. (2010). *Hydropower, territory, community: lessons and perspectives in the corporate social responsibility's context*. Third Alpine Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

[86] Rodondi, A. (2010). *The Plan for the Water Balance of the Province of Sondrio*. Third Alpine Water Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

to apply signing the Agreement “for the sustainability of the uses of water in the Province of Sondrio through the integration of the planning instruments” and participated in the implementation of the foreseen steps.

The Agreement envisaged the integration of the “Territorial Plan for the Provincial Coordination“ with an “at small scale” water balance, the individuation of a set of indicators suitable for the implementation of the WFD principles and the submission of this new plan to the Strategic Environmental Assessment, as required by the national law.

The new plan, adopted on July 2009 and approved on January 25th 2010, with the associated set of rules does constitute the instrument used by water Authorities for the grant of new concessions.

The authorization for new applications is submitted to the respect of an ad-hoc set of rules that takes into account both hydrological, environmental and morphological aspects, the used indicators are carried out using the WFD clues.

The adopted method is based on a multi-criteria evaluation aimed at excluding or limiting new concessions in those parts of the basin where there is a significant risk to deteriorate the actual water quality status or not to reach the good ecological status on the terms foreseen by the 2000/60/EC directive. The aggregation approach used for the implementation of the multi-criteria procedure was the overlapping of five different maps, where each of these maps represented the risk of not reaching the good ecological status due to a single critical aspect. In those parts of the basin where at least one of the critical aspects was characterized by a high risk rate, water concessions were excluded, while in the areas characterized by a medium or a low risk rate water concessions were allowed, on the condition that they would have not deteriorated the ecological status of the stretch.

The method provides a simple evaluation scheme that consists of a “risk map” where the different river stretches colour represents the risk of not reaching the good ecological status by 2015.

The five indices used to identify the different river stretches critical points are listed below:

- An index representing the impact of the cumulated withdrawals, with respect to the mean annual natural discharge;

- An index representing the impact of the cumulated withdrawals, with respect to the mean annual low flow considering the human activities impact;
- An index representing the interruption risk in the river regime, due to the presence of discharges from reservoirs;
- An index representing the LIM pollution risk in the "mean annual low flows considering the human activities impact" scenario;
- The FFI (Fluvial Functioning Index), for the connectivity and the ecological functionality.

Results from this method have been integrated into the Territorial Plan for the Provincial Coordination and they have also help updating the Water Quality Protection Plans at regional level and the Transitional plan for the hydro geological settlement (PAI) on the parts regarding the concession grant for water uses.

3.3.2 The evaluation of the environmental and social impacts of the hydroelectricity withdrawals: criticalities and perspectives in Valle d'Aosta [87]

The total number of derivations insisting on water bodies in Valle d'Aosta, including those for irrigation and hydroelectric purpose, is higher than 1500. The impact of such an amount of derivations is high, as described by the fact that the plants being concessionaries of bigger derivations (31 in total) generate a mean power of about 465.000 kW.

Over the years, water streams in Valle d'Aosta have been subject to modifications and pressures, due to different factors. Among them, it is worth recalling the construction of physical flood barriers having an impact on water ecosystems or their alteration deriving from anthropogenic pressures (e.g. agriculture, soil usages, sewage loads). As a result, natural water streams in the region have been strongly modified over the past years.

[87] Rocco, R. (2010) *The evaluation of the environmental and social impacts of the hydroelectricity withdrawals: criticalities and perspectives in Valle d'Aosta.* Third Alpine Water Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

The water quality indicators available nowadays to measure the impact of the modifications on rivers are not suitable to describe the actual state of water stretches in Valle d'Aosta. A practical need has emerged for a deeper analysis of the impact of hydropower and other derivations on water flow regimes. It is known that water flows are complex systems and the impact of derivations on them (influencing primarily water quantity) cannot be studied separately from other concomitant factors which add up to them. Appropriate criteria would be needed in order to describe more in detail, and providing quantitative data in support to, the multifaceted impact of hydropower on water flows in mountain regions.

In this line, the region of Valle d'Aosta is working out a new methodology to evaluate and monitor hydraulic withdrawals, aiming to preserve water flows and their quality on its territory. The main parameters to consider when setting up a set of criteria identifying a properly managed river are therefore, basically, the achievement of a "good status" of the water flows (quality indicator), and the residual flow (quantity indicator) in the water stretch, in accordance with the Regional Water Protection Plan (2006). The new indicators will be developed to implement the WFD 2000/60/CE. The resulting definition of minimum residual flow (MRF) generated refers to both quality and quantity criteria.

The residual flow (RF) is the flow that has to remain downstream of the withdrawals, in order to maintain and preserve the quality and the functioning of the ecosystems interested. RF is thus a central management factor for surface water withdrawals. In this perspective, the existing derivations impacting on compromised situations are modified in order to comply with the quality and quantity objectives set by the Water Protection Plan (WPP). The new derivations on the other hand need to meet the criterion of compatibility with the environmental and ecosystem conditions of the water stretch, either currently observed or as defined by the WPP.

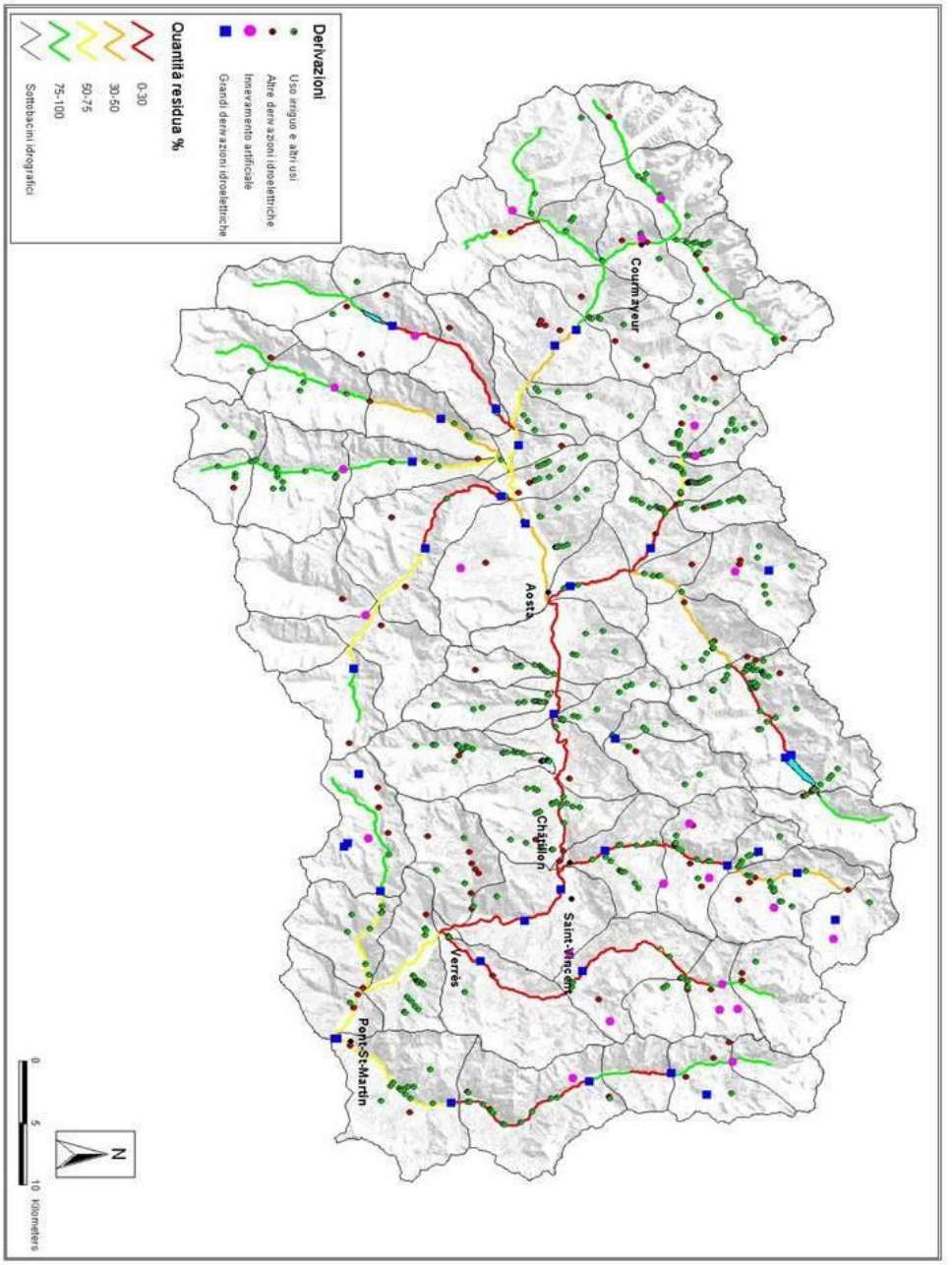


Figure 3.11 - Map of mean annual residual flows in Valle d'Aosta Region (Rocco, R. 2010)

The innovation of the system is represented by the determination of the MRF according to 5-years investigations aimed to define water flows and withdrawal quantities needed to ensure the conservation of the river's environmental status. During the experimental period, the derivation fee is reduced by 50% for the concessionary. The main 28 derivations managed by Compagnia Valdostana delle Acque (CVA) group take part in the experiment: 10 of them insist on the Dora Baltea river, the other 18 on some tributaries. The experimental project has been applied to both existing and new derivations.

The Compagnia Valdostana delle Acque (CVA) started the first experimental project to evaluate the RF from the existing derivations (Figure 3.11). The aim of this project is to increase the value of the hydroelectric energy, according to the objective of the Water Protection Plan. To overcome the limits previously encountered, three main points have been considered to define the experimental method:

- identify the variable influenced by the releases (environmental, economic and social);
- establish by appropriate methodology the qualitative-quantitative relations between hydrological regimes and their variables;
- identify the better management approach.

The experimental process lasts 5 years, with end foreseen in December 31st 2013, and the final aim of the experimentation is to the identify the RF to release downstream of every derivation. The environmental aspects are considered during the experimentation and are more difficult to be evaluate comparing to the economic loss derived from the releases.

In addition to the variables previously used, the new ones considered for each derivation were based on criteria of:

- management
- spatial continuum
- inter-annual variations
- inter-basin variations

The experimentation is on almost 95% of the derivation on the territory of the region and it also has been applied on new derivations. One of the problem encountered is the rising conflict between local authorities and producers

(economical interest), showing that the old legislations and procedures cannot be applied to the actual scenario. To overcome these conflicts the Valle d'Aosta Region tightened the criteria for the concession of new derivations, generating as a consequence the block of the concessions of new derivations.

3.3.3 The CH_2OICE project [88]

The project CH_2OICE (Certification for Hydro: Improving Clean Energy) has been developed with the aim to support an "eco-friendly" hydroelectric production because the artificial changes of water streams, such as dams or water withdrawals, have an effect to the environment on different levels. The ecosystem, in particular of the water stream itself, is primarily affected by these changes (for instance the hydro peaking phenomenon). Moreover, also the total geomorphic dynamics and the landscape are eventually modified.

The difficulties to define the impact on the water stream environment mainly derive from the absence of common criteria and the lack of specific instrumentation to its measure. In this scenario, the two major EU directives, regulating the increasing demand of water power plants for energy production (RES-e, 2001/77/EC) as well as the impact on the water flow (WFD, 2000/60/EC), have contradictory objectives. The conflict between these two directives could lead to contrasts at local scale between the energy producers, who aim at increase energy production, and the local entities that try to put restrictions to the producers. As a final effect, the process generation of new water concessions for the generation of hydroelectric energy could potentially be hampered and became inefficient.

CH_2OICE aims at developing a scientific valid and credible method of certification for the generation and the maintenance of hydro power facilities, involving different Countries (such as Italy, Slovenia, Belgium, France, Spain and Slovakia) and different partners, including hydroelectric producers (such as APER and little hydroelectric producers), groups that are protecting ecosystem and water stream (such as WWF).

[88] Conte, G. (2010). *Environmental impacts and hydropower production: the CH2OICE project: criteria and procedures for an "eco-friendly" hydropower*. Third Alpine Water Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

The method of analysis of CH_2OICE is coherent with the WFD criteria (Physic-chemical, biological and hydromorfological quality). Moreover, the procedure is site-specific and tightly connected with the real impact on the ecosystems: it asks for a preliminary environmental study that analyses the state of fact and the pressure factors tied up to the presence and the management of the plant. The mitigation/compensation measures must be included in a management plan of the plant and submitted to monitoring: all the meaningful structural/managerial variables must be identified, the same mitigation measures must be applied followed by the consequent monitoring plan. It foresees the involvement of local actors with the purpose to reduce conflicts. For some implant categories (waterworks/sewages) the procedure of certification is simplified.

The procedure implies that after a preliminary analysis the producer decide whether the certification is feasible and whether to use a standard (figure 3.12) or a simplified procedure. The analysis of the impact of the implant is based on some guidelines that standardize the evaluation procedures and reduce the subjectivity of the analysis.

Once the analysis is performed, the producer asks to the local certification authority for an audit that eventually may certificate the implant. The following years the auditor visit and analyse the implant, and a final analysis is done after 6 year from the certification. The system has been test so far on 8 implants in Italy and Slovenia.

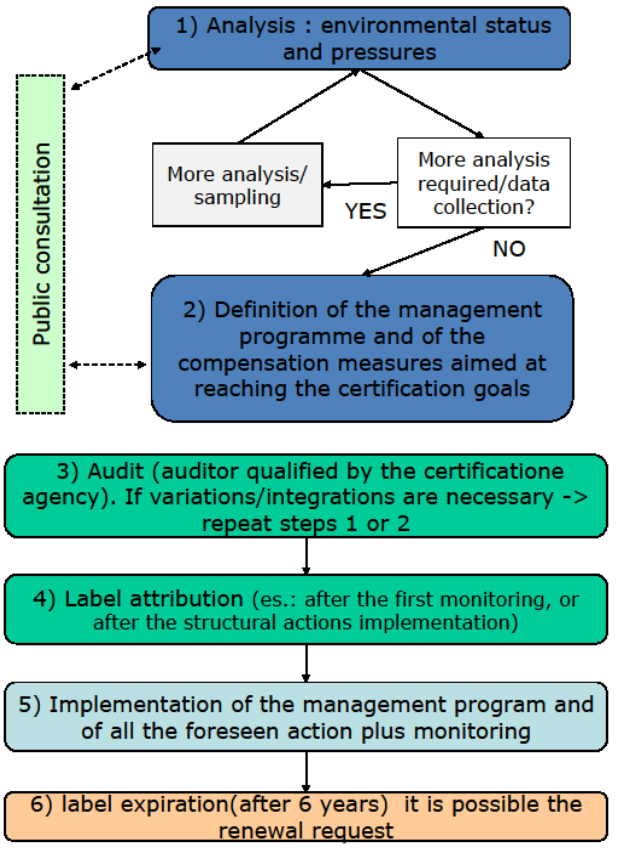


Figure 3.12 - CH_2OICE procedure steps (Conte, G. 2010)

3.3.4 The SHARE project [89]

One of the main issues that the Piemonte (Piedmont) Region has to deal with is the discrepancy between the high demand of water concessions for hydropower plants and the actual need of new hydroelectric energy production. In November 2009, 404 new applications for new small hydropower plants installations have been sent to regional authorities, of

[89] Clemente, F. (2010). *Ricerca di soluzioni per la compatibilità dell'idroelettrico in montagna: il Progetto SHARE.* Third Alpine Water Conference, Preparatory Workshop n. 3, Sondrio, Italy, 26th October 2010.

which 220 on natural water flows. In contrast, only 20% of new power plants would be enough to produce 80% of the total hydroelectric energy (gross production potential) (figure 3.13). Thus the question that raise from this view is how to support public authorities (and namely the provinces, in Italy) to evaluate the demand of new concessions, in order to avoid to extensively authorize or hamper the installation of new not necessary hydroelectric power plants. Moreover, the potential economic benefits brought to small local districts could generate a wish to install new hydro power plants on their territory.

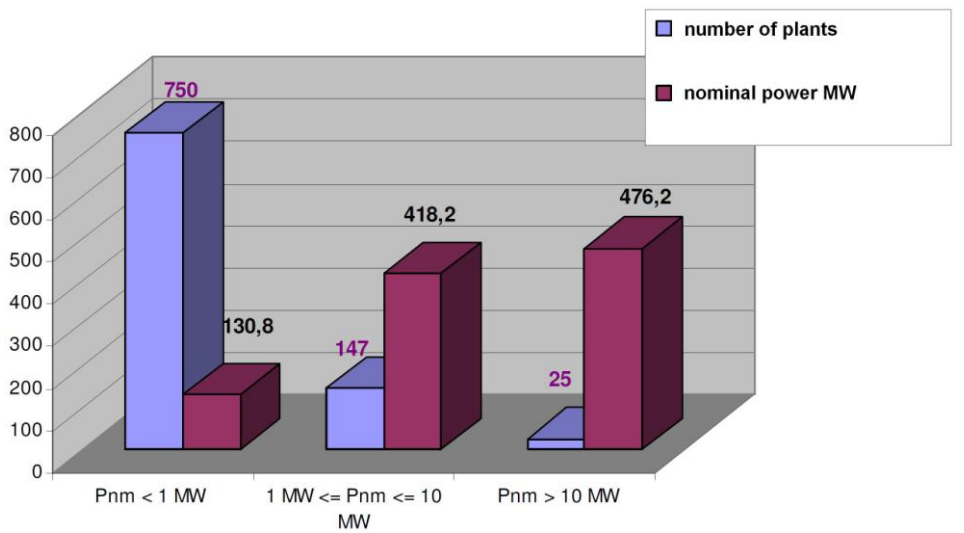


Figure 3.13 - Number of plants and share of energy production for each production class (Clemente, F. 2010)

Based on the forum "Acqua-Energia" ("Water-Energy") held in April 2009, a *Report on the advancement of the reform and the state of water service in Piemonte* has been approved in September 2009 . Main topic approached in this document can be summarised as follows:

- the identification of natural areas to be preserved from the installation of hydroelectric plants,
- the individuation of the residual potential and the room available to develop new installations within each area, taking into account the past exploitation and the achievement of water quality goals,

- apply exclusion/repulsion/attraction criteria for the localization of new installations (pre-planning).

The pre-planning approach is particularly important for river basins in Piemonte because some of them are at risk of not achieving the "good status" as required by the WFD. Moreover, it has been recognized that some of the indicators previously used to define the impact are not enough sensitive and therefore their value cannot be used to determine the impact in this area.

The SHARE project tries to respond to some of the challenges faced by Regione Piemonte. This 3-years project (August 2009 to July 2012) aims to develop and test a decisions support system that may help merge the partially opposite needs to improve the production of hydropower and assure the maintenance of a good condition in the interested water bodies. One of the purposes of SHARE is to give to the competent authorities a set of criteria to deal with the rising demand of new concessions, and to provide the right methodology to evaluate the impact that new plants would generate on the water flows, as well as their social and economic impact.

The SHARE project has been working to adapt already existing scientific methods to the requirements of the local, national and international legal systems. The project includes a test phase that considers 11 case-studies. In addition, the project will create alternative, novel criteria to assess the available data. The methodology that will result from SHARE will allow a completely different approach than the one used before. The SHARE methodology is based on the Multi Criteria Analysis (MCA). The benefits of MCA are that it allows to synthesize complex information and to rationally organise the available data in a structured way. Being multi criteria, it allows considering different managerial objectives and the different alternatives. Working with indicators, criteria and weights, it is possible to address different situations, linked to different administrative levels: local, regional and national.

Confronted with a concrete situation, the SHARE methodology analyses the identified potential alternatives, score each of them considering several criteria (impact on landscape, value and quantity of energy generated, eventual benefits to tourism, consequences on the local economy, effects on game fishing, etc.). The best available option then needs to be considered and validated, according to the local and specific features of the case study.

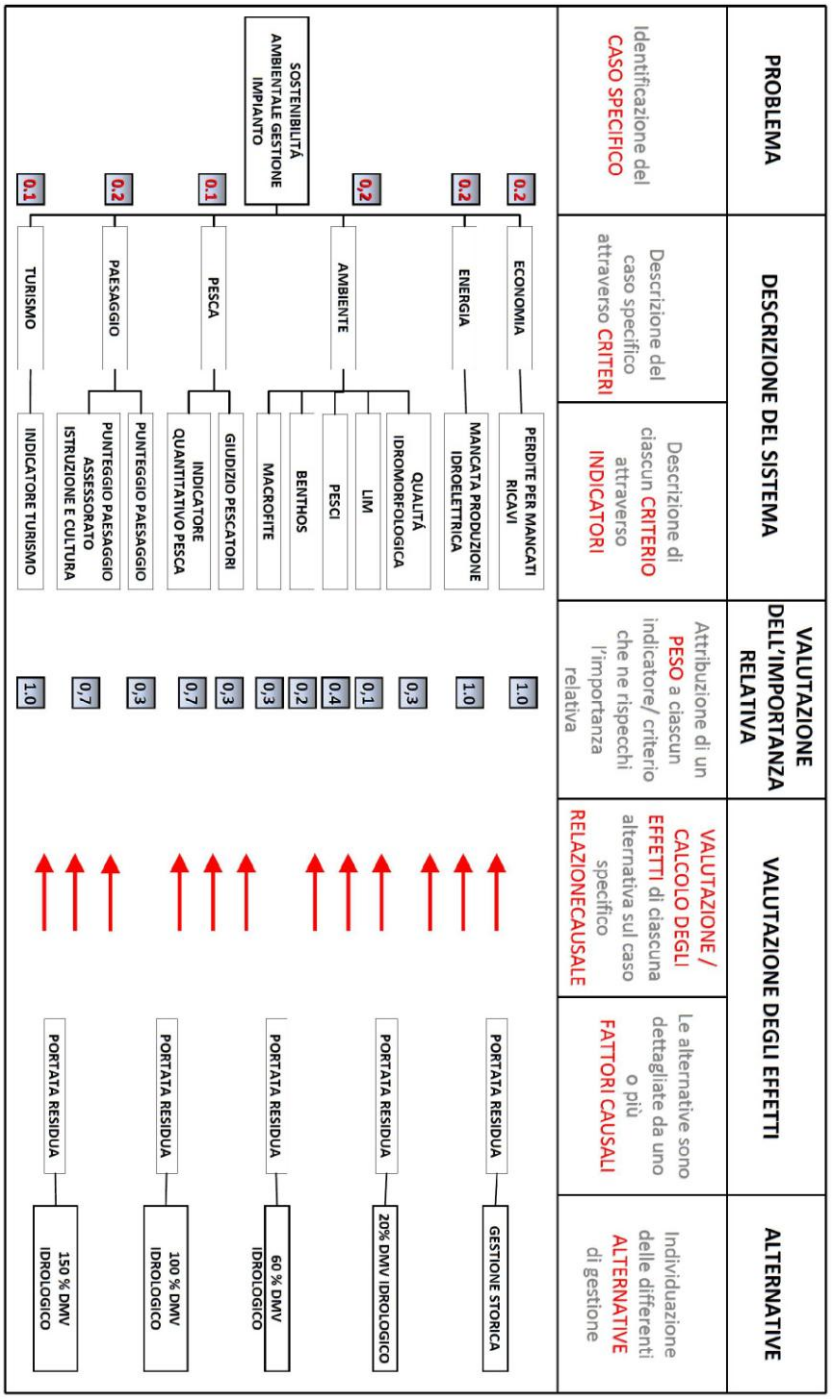


Figure 3.14 - SHARE Project multi-objective evaluation scheme (Clemente, F. 2010)

The whole process is transparent and replicable, the methodology is in line with the legislation in force, and it can be used both for planning and management purposes. Moreover, it encourages the dialogue between public and private subjects, by providing a sound basis for it, represented by concrete parameters (see Figure 3.14).

3.4 The common guidelines for the use of small hydropower in the Alpine region [90]

At the 10th Ministerial Alpine Conference held in Evian in March 2009, the Ministers of Alpine Countries discussed the need for common principles and recommendations in order to guarantee a sustainable and well-balanced use of hydropower in the Alps. For this purpose, they also approved the Climate Action Plan setting up the guidelines for construction, optimization or refurbishment of small hydropower plants reducing impacts on the aquatic ecosystem.

In this context the Water Management Platform deals with the water-related issues and challenges in the alpine perimeter, aiming at an exchange of experiences, best practices and examples among the Alpine Countries. Members of the Water Management Platform are representatives from Member Countries (national administrations), from the official observers of the Alpine Convention and from appropriate stakeholders from both the use and the conservation part. Austria and Switzerland jointly chair the Platform for the period 2009-2011.

According to the working program 2009-2011 the main goal of the Platform is the elaboration of common guidelines for the use of small hydropower plants in the Alps. The proposed guidelines have to be consistent with the existing national and regional guidance documents, in order to implement the principles of integrated water resources management, by increasing the production of renewable energy from hydropower generation while minimizing the impairment of the aquatic ecosystem and landscape. The specific objective

[90] Platform Water Management in the Alps of the Alpine Convention (2010c). *Common guidelines for the use of small hydropower in the Alpine region*. Draft on discussion at the 3rd Alpine Water Conference.

of those guidelines is to provide general direction for the identification of potential fair locations for small hydropower plants and for the succeeding authorization decision, in accordance with the principle to assure the sustainable development of the Alpine region. Thus it is strongly recommended to strike the balance between an increase of hydropower generation and environmental protection, and to carry out a transparent weighing of the interests based on sustainability criteria.

More in detail, the guidelines specifically consider the perimeter of the Alpine Convention (i.e. the Alps); address small hydropower, give recommendations for the authorization of applications for new small hydropower plants without exerting any legally constraining force.

Since different plant types have a distinct impact on the aquatic ecosystem, the guidelines have defined two broad groups of plant types: run-of-river power plants and infrastructure-related power plants. The first group considers the diversion hydroelectric plants related to an abstraction and diversion of water and the through-flow power plants with no diversion but run-through regime. The second group consists of plants, also called multipurpose, which are integrated to the network of the drinking water supply, or to the waste water disposals or irrigation infrastructures, as well as of plants which exploit residual flows or fish migration aids flows. Generally, those plants do not additionally impact on the aquatic ecosystems and they are economically favourable because they employ only the water that is previously used by the primary end of the facility. Therefore, multipurpose small hydropower plants can be considered appropriate and desirable for ecological safeguard of the aquatic ecosystems. Moreover, when small hydropower is used for the electric auto-supply, where the connection to the public grid would lead to disproportionate costs and no better environmental options are given, it constitutes a strong argument in favour of building small hydropower in such remote individual locations (e.g. Alpine huts, remote farming, etc.).

The guidelines generally promote and prioritize the refurbishment of existing operating plants and the reopening of disused plants, in order to optimize the production of hydropower and to minimize the ecological impacts. However, they need a periodical control and several tests to maintain good ecological standards, according to the existing environmental legislation. The renovation and readjustment of old plants (according to the environmental legislation in

force) is generally financed by incentives to go beyond the minimal requirements.

The renewal of concessions or licenses can generally be considered appropriate in case it complies with the existing environmental legislation. Nevertheless, the ecological potential of the site should be considered, and concessions or licenses should be limited in time, being as short as possible without compromising investments.

The procedure for assessing new plant installations is characterized by two requirement levels, 1) of a regional and 2) at a local scale. In the first case the key question is to find where the most favourable locations are, to build and to operate small hydropower, while in the second case the question is how projects can be realized. Figure 3.15 and Figure 3.16 report the classification scheme used at the regional level to define the potential appropriateness resulting from the comparison of the two considered aspects. This first level provides a coarse assessment from a regional and strategic point of view that needs to be considered at the local level, where the actual authorization decision with a more in-depth assessment takes place. At this level only the specific location is considered but not the specific criteria of the installation.

For the evaluation of the individual application, all sustainability aspects have to be considered and all the relevant criteria of the project have to be taken into consideration (weighted). Therefore, the idea is to start from the general level related to the regional point of view to a more detailed level linked to local issues. Some alpine countries included have different authorities for setting-up strategic planning and granting concessions. In such an institutional situation, it is important that authorities responsible for granting concessions are also involved in the strategic process.

The regional strategy aims at classifying the potential suitability of water bodies for hydropower use independently from individual application, considering only the hydroelectric potential, the ecological and landscape value.

Instead, at the local level, the assessment focuses on the local situation and the individual applications by weighing all pros and cons, and considering the estimation made at the regional level, the installation and site specific criteria and further socio-economic aspects. The common guidelines give also some directions to follow for the procedures at regional and local scale.

The strategic planning at regional level has to be a transparent evaluation and classification of the potential suitability of river for hydropower. It has to take into account water hydroelectric potential, ecological and landscape value and legislation for the areas under special protection. At the regional level designation of areas that are deliberately kept free from any exploitation, avoiding irreversible impacts should be judged by a broad participation of relevant stakeholders.

The regional strategy meets the requirements of EU-WFD that sets out the conditions for exceptions in case of deterioration of water status or failure to achieve good water status. It is asked for a weighing of benefits (e.g. benefits of modification, benefits of water protection or public interest) and for the examination of better environmental options to reach the objective of the water body's modification at whole region or catchment level. The regional strategy, in particular, responses to requirements of art. 4.7 of the WFD.

Regional planning has to propose the potential methods that can be applied to integrate the results obtained by the strategic planning in the existing national or regional instruments, as the river basin management plans or other spatial planning mechanisms.

The regional strategic approach takes into account several international and EU sources, including: EC Communication on the support of electricity from renewable energy sources; Note of the EU Water Directors on "Hydropower development under the WFD"; Policy Paper (2007) on "WFD and Hydro-Morphological pressures" and the SHERPA Project (Small Hydro Energy Efficient Promotion Campaign Action).

CRITERIA	DESCRIPTION
Classification of the ecological status	*Classification of river stretches according to WFD or Swiss Modular Stepwise Procedure* [32]
Hydrologic regime	Minimal flow, flow fluctuation, impounded length…
Morphology	Natural structure and barrier free flow path, longitudinal connectivity
Biology (qualitative and quantitative)	Fish, macrozoobenthos, diatomea…
Possible additional criteria: Chemical water quality Thermal regime Bedload	
Type of water body	
Rarity of the water body type	
Sensibility of the water body type	
Rarity of the high status class within the water body type	
Importance as habitat	
Rare / protected habitats	Importance; fish spawning area, etc.
Importance for protected species	Fauna and flora
Rich species spectrum / diversity	Fauna and flora
Possible additional criteria: longitudinal connectivity transversal connectivity Fish waters	Waters suitable to sustain natural fish populations
Landscape value	
Protected areas	Depending on the protection level and the interaction with the water body
Recreation value	
Beauty	Scenic attraction, symbolic value, local identity
Importance for the whole river system	Considering the specific function for the other stretches in the river or (sub)basin

Sites / zones that can justify the classification "non-favourable for hydropower use"

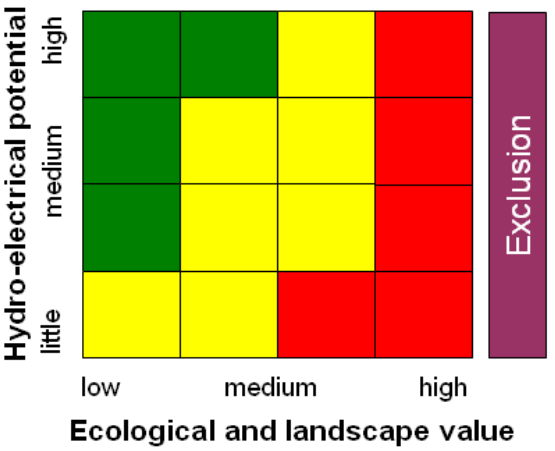
Even if no limitation for hydropower is set by law, sites with high ecological and landscape value should get special protection and therefore be considered as "non-favourable for hydropower use" [33]. Such sites are listed below:

Sites located in one of the following zones:
National parks
Water related Nature2000 sites
Water related landscapes or natural monuments of national / regional importance
River stretches and biotopes of national / regional importance e.g. according to the rarity of type or naturalness or specific function for the river system
Revitalised or river stretches foreseen to be revitalised
Sites with one of the following characteristics:
Floodplains (wetlands, marshlands, riparian zones, dynamic and braided river stretches …)
Important spawning areas
Residual flow stretches [34]
River stretches with fish and crayfish populations of national importance
Interference with the protection of water resources for drinking water supply (drinking water protection zones)

Exclusion areas

Based on the applicable legislation, there may be sites where, due to their unique ecological and landscape value or to local spatial planning, any further use for hydropower generation is forbidden by law. These cases represent "Exclusion areas" and depend on the locally valid legislation, thus they are not explicitly listed as criteria.

Figure 3.15 - Issues to account for in the classification of the suitable/non suitable areas at regional scale. (Platform Water Management in the Alps 2010c)



FAVORABLE for hydro-electrical exploitation	LESS-FAVORABLE for hydro-electrical exploitation	NON-FAVORABLE for hydro-electrical exploitation. Strong interest for conservation	EXCLUSION hydro-electrical exploitation forbidden by law
complying with the legal environmental (and other) standards, construction of SHPs in general possible	additional aspects and in-depth assessment weighing all relevant criteria indispensable next to complying with legal environmental standards, possibly further or stricter requirements may be necessary	SHPs possible only in exceptional cases (e.g. auto supply)	No hydro-electrical exploitation possible since protected areas where SHPs are forbidden by law

Figure 3.16 - Classification scheme for a river stretch aiming at defining suitable locations for small hydropower plants from a regional, strategic perspective (Platform Water Management in the Alps 2010c)

Taking into account the results of the evaluation made at the Regional level, the authorization decision has to be made at the local level. In this case the definitive concrete assessment of the project application has to be delivered. The authorization is not just about judging if projects should be allowed in certain areas or not but also about the way how projects should be realized (figure 3.17). In particular, the site and the specification of the installations have to be indicated and additional requirements can be asked, if needed.

CRITERIA	UNIT	DESCRIPTION
Energy balance or "energy payback ratio"		Energy input for the construction of the installation and operation compared to the energy production (e.g. expressed as number of years until energy output > energy input);
Specific investments	€/kWh	Euros (or Swiss Francs) per expected annual production of the installation
Use of hydroelectric potential	%	Extent of use of available potential including consideration of residual flow requirements and qualitative description of the reasons if the available potential is only partly used.
Minimisation of impacts		Measures going beyond minimum legal requirements (e.g. with respect to ecological flow, fish pass, bed load, aesthetics, natural scenery, etc.)
Synergies with existing infrastructures		Infrastructure plants or existence of a deactivated plant
Sewage dilution coefficient on the residual flow stretch		
Ecological impacts downstream and upstream		
Integration in the landscape		
Grid relevancy		e.g. Importance for the grid stability
Possible additional criteria for the comparison of applications competing on the same river stretch:		
Specific power output	kW/m	Power output related to the length of the residual flow stretch and impounded river length.

CRITERIA	DESCRIPTION
Conflicts with other water users	Locally, downstream and upstream
Conformity with local spatial planning	
Necessity of further infrastructure for construction and operation	Access, power-lines, etc.
Effect on tourism	Potential positive and negative effects on tourism
Regional economic effects	Taxes, income for the public; investments in local economy, induced employment
Self supply necessity	If distance to the public grid too long and no better environmental option is given.
Relevant certifications[35]	e.g. green energy labels; ISO 14000 ; ...
Other socio-political considerations	

Figure 3.17 - Installations, site specific criteria and further economic criteria (Platform Water Management in the Alps 2010c)

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Annex 1

Outcomes of the Conference and the Preparatory Workshops

The two-days Conference, as well as the three Preparatory Workshops that preceded it, offered the opportunity to tackle the issue of "Water in the Alps" from different points of view, covering several aspects of great interest and relevance for those who live in this area.

The Conference was a precious opportunity to take stock of the implementation of regulations, plans and programmes in the alpine context and to look at open issues related to the key topic of the safety of settlements and infrastructures. In this context, European directives 2000/60/CE and 2007/60/CE are reference documents also for non-EU regions (Switzerland and Liechtenstein) which participate in the Alpine Convention and in the Alpine Space Programme, as well as in many other cooperation projects at the alpine level.

During the meetings, it emerged how water has always been an important resource and an attractive factor in mountainous areas, but at the same time it deserves careful attention and can represent a risk for human settlements. In the past fifty years significant social changes have lead to changes in the way in which soil is used, increased numbers of inhabited settlements, the growth of economic activities, and an increase in mobility and connections – which have in turn increased the sensitivity of territories. On the other hand, a whole host of actions targeted at planning soil utilisation, improving forestry resources and the stability of slopes, monitoring events, identifying and foreseeing hazards and risks, building and maintaining preventive works, and managing emergency situations through civil protection procedures and actions have also been implemented.

Climate change is threatening to further accelerate processes; it is therefore necessary to maintain high levels of land protection and further improve prevention and safeguard measures.

An integrated approach is proving to be more and more necessary and effective. Such approach shall also take into account non structural (such as land planning, land use, effectiveness of protection forests) and cultural measures, such as the information and involvement of the population to promote responsibility and adequate behaviours.

The long return times referred to by documents add to the complexity of the situation (for instance, the Floods Directive foresees up to five hundred years), as this makes both statistical and physical evaluations very complex to characterise.

In this framework, introducing the concept of residual risks becomes relevant. This shall promote a widespread social dialogue in case of out-of-scale events which may be beyond the scope of projects. Furthermore, in case of superficial landslides and debris flow events, comparisons can only be made by referring to the rains which have generated them.

Science and technology can certainly provide highly sophisticated tools to evaluate hydrogeological hazards (landslides, rock collapses, floods with liquid and solid elements, influence of the thermal zero) and to monitor and foresee phenomena which are always very complex and dependent on factors that sometimes cannot be detected with sufficient accuracy. Modern tools for land analysis (satellite surveys, laser altimetric surveys, ground measuring networks, various mathematical models, tools for the massive treatment of heterogeneous data, statistical and dynamic models) are a unique opportunity and provide a level of reliability which has never been achieved before.

The prevention of hydrogeological risks in the mountains is the result of the integration between hazard evaluation, the analysis of the event, of the land structure and of threatened elements, of repair and protection measures and of civil protection resources. In order to improve safety, it is therefore necessary to act on all these factors. Also, cooperation among Alpine regions is important, as it allows to compare different organisational models and experiences, and to rely on a wider database.

During the meetings, Regions and Basin Authorities have exchanged ideas on their respective experiences, with particular reference to the zoning of hydrogeological hazards. The discussion highlighted how the maps resulting from such exercise haven’t always been translated into constraints in urban

planning activities.

Austria has been carrying out planning activities on hazard areas for decades; this is an important tool when drawing up evaluations and programme planning activities, however it does not have an automatic influence on land planning. The Swiss approach has a clear methodology for the identification of zones, but this does not automatically translate into land use constraints.

In Italy, the analysis of areas subject to hydrogeological hazards is the result of the implementation of Decree 180/1998 and is required for the definition of PAIs (*Piano stralcio per l'Assetto Idrogeologico – Drafts plans for the hydrogeological structure*) by Basin Authorities, while the autonomous provinces of Trento and Bolzano have carried out hazard studies and risk analyses in the framework of the General plans for the use of public waters. In particular, in the Trentino area, the new Provincial Urban Development Plan (2008) introduces urban development constraints for hazard areas, while risk maps will be used to plan protection and prevention actions, and will also be used as a tool to manage emergencies.

Public Administrations have made different choices in terms of risk analysis: some have chosen to carry out analyses and draw maps themselves, ensuring methodological consistency and a tighter control on the process of definition of areas; others have entrusted Municipalities with the task of drawing risk maps, while the Region is responsible for defining guidelines and producing reference materials.

During the meetings, it emerged how alpine forests can contribute to a significant reduction of natural risks enhanced by climate change, such as avalanches, landslides, floods or draughts, thus protecting settlements, the economic system, touristic areas, water production and many other activities carried out in these areas. On the other hand, climate change can have several negative impacts on alpine forests: it can influence the growth and health of forest ecosystems, change the distribution and development of tree species in the Alps, jeopardise the economic value of forests, spoil the scenic beauty and the landscape, and have an adverse effect on tourism and the local economy.

Nevertheless, there is a high level of uncertainty on how the many functions of forests can be influenced by the consequences of climate change. In this context, the MANFRED project becomes particularly relevant. This project aims

at defining management measures to adapt the forest located in the Alpine Space to the climate change related risks. The project has two objectives: the protection and safeguard of forest ecosystems and the promotion of an effective management of forests through adaptive strategies based on knowledge.

As for the safeguard of water ecosystems, it emerged that the River Basin Management Plans (RBMPs) foreseen by the Water Framework Directive are implemented in all EU countries, and Switzerland follows a similar planning process. The analysis of such plans shows that, although the environmental quality of alpine water bodies is generally good, only some of those which still have not reached a good qualitative status will be able to meet the Directive objectives by 2015.

The RBMPs must be implemented with a clear and realistic approach – which may sometimes require bold choices – limiting the use of derogations as much as possible. To this end, it is necessary to establish - on the basis of economic analysis (which must still be adequately developed in the Plans) - that the costs for the implementation of the plans shall be carried by the users of water resources (tariff or fee), according to the "polluter pays" principle.

A structured monitoring activity, in compliance with the Directive requirements, is one of the key actions needed to guide and fine-tune useful actions to achieve environmental quality objectives. In Italy, the state of quality in the Plans shall be reviewed on the basis of the results of the monitoring activities carried out in compliance with the recent Ministerial Decree DM 56/2009.

Data and statistical analyses in the environmental field are essential to plan and manage water resources, but it is necessary to use common indicators in classifications and calculation methodologies, so that these can be compared. There are still difficulties in finding statistical data, sharing standardised classifications, as well as a lack of adequate measurements. In some areas, the level of knowledge is still completely inadequate, such as in the case of consumption of underground waters.

For the next cycle of European financial planning it is necessary to have, among other things, more detailed studies on the optimisation of the monitoring network – especially at high altitudes – and on the actual effects of climate

change.

Hydromorphological impacts – particularly those generated by the hydroelectric sector – are among the main criticalities affecting alpine streams and water protection works. However, the classification tools used in Management Plans are not very sensitive to hydromorphological pressures, and in the case of alpine rivers – which generally present a good quality of waters – they tend to overestimate environmental quality.

River or lake contracts are a useful tool for negotiated planning and promote a "harmonious" implementation of plans and programmes covering very wide ranging issues. From this perspective, Contracts can be a very effective tool for the implementation of Management Plans, similarly to what happens in France, where River or Lake Contracts have now become a common practice. River Contracts help achieving the environmental quality objectives of water streams through forms of involvement and widespread participation (of both public and private subjects).

They do not create further procedural constraints and – while respecting the respective competences and commitments of all parties involved – make investments more effective by integrating and guiding the economic resources and plans of a territory.

For the future 2014/2021 programming period, it is essential to require the inclusion of Alpine mountain territories among the areas of particular interest at a European level, for which specific resources supporting processes (involving local communities) and programmes for the safeguard and protection of these territories – which still play a fundamental role as biodiversity and environmental hotspots – should be earmarked.

Regarding the topic of the hydropower generation in the alpine region, the Conference highlighted the urgent need to provide concrete responses to two distinct environmental policies, one on water (2000/60/EC Directive) and one on climate (2009/28/EC Directive). These directives are the reference also for the regions not belonging to the EU (Switzerland and Liechtenstein) but members to the Alpine Convention.

The production of hydroelectric energy in mountain regions has always been an important resource, a wealth generating factor, but also an element that affects the landscape and river ecosystems, which however has been generally

accepted by local populations, at least so far.

However, the need to foster energy production from renewable sources to comply with the obligations imposed by European directives (2001/77/EC, now replaced by 2009/28/EC) has implied a considerable increase in government incentives, making projects cost-effective that until a few years ago would not even been taken into consideration. In effect, this translated into a boom of applications for concessions for new hydroelectric power plants, especially of small size, that would be added to the already high number of existing facilities.

The features of water as a limited asset, associated with some typical traits of the relevant industry and with other local and environmental aspects, however, make the full exploitation of the available resource for the production of energy non sustainable. The following reasons can be listed among many more: conflicts in the use of water resources; the environmental impact of the hydroelectric use of water; the impact of production and of the construction of hydroelectric power plants on the landscape; the established presence of large systems and large basins that cover the nearly total availability of large water diversions; the desire to diversify investments and the economy in mountain areas where hydroelectric power plants are located.

Recently, a growing need to limit the further exploitation of waters has been observed among Alpine populations, while also it seems also to be important having a greater share in the allocation of the relevant economic yield of the hydroelectric industry with greater benefits for local areas, similarly to what already happens in some Alpine areas (Autonomous Provinces of Trento and Bolzano). In Italy, these needs have generated law-making initiatives such as the approval of article 15 of Law 122 dated 30 July 2010, which gives the Provincial Authorities the opportunity to be part in the management of the power plants, as well as an immediate increase in fees.

The scope of these law-making initiatives has not yet been fully understood. While it is generally accepted that fees can be a significant tool for the government in order to create and allocate a yield, for example by differentiating them on the basis of the effects of the action on the watercourse, or by establishing mechanisms to remunerate those who take steps to recover/improve the ecosystem functions of the water course, there are serious doubts about the penetration of the Public Sector in the industries

which it regulates, especially with respect to plant concessions and management. The controlling entity and the controlled entity should in fact be distinct entities with distinct roles.

Regarding economic incentives for the production from renewable sources, such incentives should be linked not only to the production of energy, but also to the impact of the plant on the surrounding landscape. The reduction of these incentives is desirable when coupled with a streamlining of the authorization procedure. With respect to this, it is worth noting that in Italy, through Decree dated 10.09.2010, the "Guidelines for the concession of plants supplied by renewable sources" have been approved.

The process for the concession and assessment of new hydroelectric power plants should be based on a two-tier procedure: one of regional strategic pre-planning (which does not mean the administrative entity but the local entity which is more appropriate for performing the analysis, such as for example, the basin or the sub-basin) which must establish where new plants can be built and, at a local level, how the plant should be built.

The benefits of pre-planning mechanisms are now widely recognized, in order to ease the definition of areas where new plants should be installed. These mechanisms should give the opportunity to detect suitable, less favourable and non favourable areas, taking into account the Water Framework Directive and other environmental and social-economical criteria, including other water uses. The use of pre-planning systems would foster the concession process making the whole procedure more transparent and quicker.

Strategic pre-planning is however a general and rough assessment which does not consider project and site-specific information. A second level of assessment is therefore necessary, which implies an in-depth local assessment of the actual project submitted on the basis of criteria regarding the plant and site-specific details and other local social-economical issues so that all relevant criteria can be weighed (at this level, the environmental impact assessment must be carried out, when it is prescribed by regulations).

Voluntary environmental certification of hydroelectric energy producers represents a possible tool for the solution of local conflicts between the needs of production and the needs of protection of water courses.

Being the prerequisite for the subsequent assessment and decision regarding

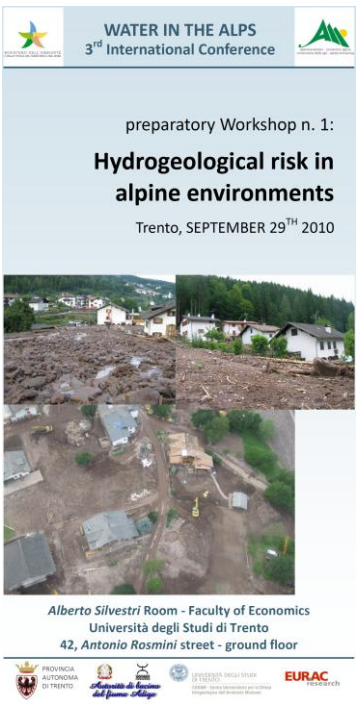
the authorization of the individual project, regional strategic pre-planning should be carried out as soon as possible to avoid a general freeze of all new concessions.

As to operating plants, the modernization and the strengthening of the existing infrastructures is absolutely necessary, in order to reduce to a minimum the need for new sites to develop further hydroelectric capacity. The economic incentives for these plants should be connected to the degree of environmental improvement in order to mitigate the impacts on the ecology and on the landscape and to accelerate the achievement of the objectives defined by regulations or even to go beyond minimum requirements.

In conclusion, Conference and Workshop participants agreed in believing that the development of renewable energies, including hydroelectric energy, must be strongly supported, but it is also important that the development is compatible with environmental and landscape protection needs.

Annex 2

Programmes of the events



Morning programme:

09.30 - 10.00	**Registration of the Participants**
10.00 - 10.15	**Welcome and introductory speech by local Authorities, Permanent Secretariat of the Alpine Convention, Italian Ministry of the Environment (M. Gilmozzi, Assessore Urbanistica, Enti Locali e Personale; M. Macaluso, Permanent Secretariat of the Alpine Convention; P. Angelini, Italian Ministry of the Environment)**

10.15 - 10.25	**Introduction to the RSA2 study and to the Water Platform (P. Colonna, member of the Water Platform or the Alpine Convention)**	
10.25 - 12.20	**1st session: (chairman: P. Colonna, "Water Management in the Alps")**	
	10.30 - 10.50	Natural risks in the alpine environments and the PLANALP platform activities (A. Zischg, Natural Hazards Platform of the Alpine Convention)
	10.50 - 11.10	From the transitional plan for the Hydrogeological System to the flood risks Management Plan (L. Guarino, Adige River basin Authority)
	11.10 - 11.30	European Directives and flood evaluation methods in alpine environments (P. Claps, Politecnico di Torino)
	11.30 - 11.50	Hydrogeological hazard in the alpine areas: science, research, perspectives (R. Rigon, University of Trento - CUDAM)
	11.50 - 12.20	Question time— Press Conference
12.20 - 13.45	**Lunch break**	

Afternoon programme:

13.45 - 16.30	**Round Table: The hydrogeological risk in the alpine environment and the 2007/60/EC Directive application (chairman: A. Armanini, Università degli studi di Trento - CUDAM)**	
	13.50 - 14.10	Autonomous Province of Trento (S. Fait, Engineer, Servizio Bacini Montani)
	14.10 - 14.30	Autonomous Province of Bolzano (P. Macconi, Servizio Ripartizione Opere Idrauliche)

14.30 - 14.50	Autonomous Region of Valle d'Aosta (R. Rocco, Engineer, Assessorato alle Opere pubbliche, difesa del suolo ed edilizia residenziale pubblica)
14.50 - 15.10	Austria, Tirolo Region (D. Kurz, Engineer, servizio Wildbach und Lawinenverbauung, Sistemazione torrenti e valanghe, Sezione Tirolo)
15.10 - 16.30	**Discussion and presentation of the final document for the 3rd Water Conference in Venice** With the participation of Veneto and Friuli Venezia Giulia Regions and Po and Alto Adriatico River Basin Authorities

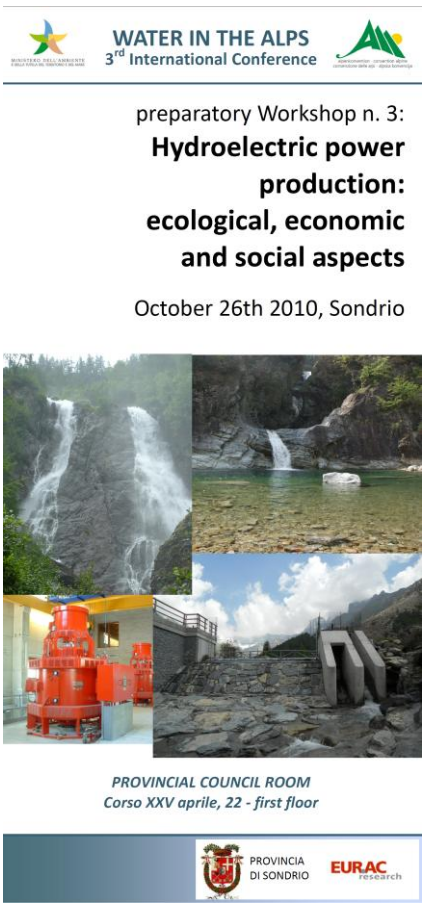
Morning programme:

09.30 - 10.00	**Registration of the participants**	
10.00 - 10.20	**Welcome and introductory speeches by local Authorities, Permanent Secretariat of the Alpine Convention, Italian Ministry of the Environment (A. Garazzino, Regione Piemonte - Direzione Ambiente; M. Macaluso, Permanent Secretariat of the Alpine Convention; P. Angelini, Italian Ministry of the Environment)**	
10.20 - 12.40	**Morning session (chairman: P. Mancin, Regione Piemonte - Direzione Ambiente)**	
	10.25 - 10.45	The Platform "Water Management In The Alps" of the Alpine Convention and the Review of the River Basin Management Plans (P. Colonna, Platform "Water Management in the Alps")
	10.45 - 11.05	The role of the River Basin Management Plans for the safeguard and restoration of the alpine ecosystems (A.Goltara, CIRF)
	11.05 - 11.25	The MANFRED project (L. Cetara, consultant for the Ministry of the environment on the MANFRED project)

	11.25 - 11.45	The forest planning and the woodland protection function: experiences in Piemonte Region (P.G. Terzuolo, Istituto per le Piante da Legno e l'Ambiente IPLA)
	11.45 - 12.05	The "River Contract" as instrument of integration and participation (E. Porro, Regione Piemonte – Direzione Ambiente)
	12.05 - 12.25	Drinking water supply and consumption in the Alpine hydrographical districts (S. Tersigni, ISTAT)
	12.25 - 12.45	Question time - Press Conference
12.25 - 14.00	**Lunch break**	

Afternoon programme:

14.00 - 16.00	**Afternoon session (chairman: P. Colonna, Platform "Water Management in the Alps")**	
	14.05 - 14.25	The Po River Basin Management Plan (F. Puma, Po River basin Authority)
	14.25 - 14.45	The "Oriental Alps District" River Basin Management Plan (L. Guarino, Adige River basin Authority)
	14.45 - 15.05	The Rhône-Méditerranée et Corse (France) River Basin Management Plan (J. Bigué, Association Rivière Rhône Alpes)
15.05 - 16.00	**Conclusion and discussion of the outcomes for the 3rd Water Conference in Venice**	



Morning programme:

09.30 - 10.00	**Registration of the participants**
10.00 - 10.30	**Welcome and introductory speeches by local Authorities, the Italian Ministry for the Environment and the Permanent Secretariat of the Alpine Convention (M. Sertori, President of the Province of Sondrio; U. Parolo, Council of the Lombardia Region; M. Macaluso, Permanent Secretariat of the Alpine Convention; P. Angelini, Ministry for the Environment, Land and Sea -Italy)**

Morning session

10.30 - 12.40 **(chairman: E. Borghi, Uncem – Italian National Association of Mountain Municipalities and Communities)**

10.35 - 10.55	Environmental impacts and hydropower production: the CH2OICE project: criteria and procedures for an "eco-friendly" hydropower (G. Conte, CH2OICE Project
10.55 - 11.15	Environmental and economic costs and benefits of the hydropower use in the Alpine environment (A. de Carli, IEFE – Bocconi University)
11.15 - 11.35	Hydropower, territory, community: lessons and perspectives in the corporate social responsibility's context (L. Cetara: EURAC research - European School of Economics)
11.35 - 11.55	The guidelines of the Platform "Water Management in the Alps" (P. Dazio, Platform "Water Management in the Alps")
11.55 - 12.15	The Plan for the Territorial Coordination of the Province of Sondrio (I. Rizzi, Province of Sondrio)
12.15 - 12.40	Question time— Press Conference

12.20 - 14.00 **Lunch break**

Afternoon programme:

14.00 - 16.30 **Afternoon session (chairman: P. Colonna, Platform "Water Management in the Alps")**

14.05 - 14.25	The Plan for the Water Balance of the Province of Sondrio (A. Rodondi, Province of Sondrio)

14.25 - 14.45	The evaluation of the environmental and social impacts of the hydroelectricity withdrawals: criticalities and perspectives in Valle d'Aosta (R. Rocco, Valle d'Aosta Autonomous Region)
14.45 - 15.05	Hydropower: the point of view of the Agency for Energy of the Autonomous Province of Trento (R. Bertoldi, Energy Agency of the Autonomous Province of Trento)
15.05 - 15.25	Research of solutions for the compatibility of hydropower in mountain areas: the SHARE Project (F. Clemente, Regione Piemonte)
15.25 - 15.35	The hydropeaking on the REPORT Project (D. Iob, Adige river basin Autority)
15.35 - 16.30	**Conclusion and discussion of the outcomes in view of the 3rd Alpine Water Conference in Venice** With the participation of F. Puma, Po river basin Autority ; G. Pineschi, Ministry for the Environment, Land and Sea - Technical Secretariat of the Ministry

WATER IN THE ALPS

3rd International Conference

Venice
November 25th and 26th 2010

CITTA' DI VENEZIA

Con il patrocinio della Città di Venezia

1st day (Thursday, 25th November 2010)

09.30 - 10.00	**Registration of the participants**
10.00 - 10.15	**Welcome of the hosting Authorities (P. F. Ghetti, Strategic Plan Assessor, Municipality of Venice, Italy; M. Conte, Environment Assessor, Veneto Region)**
10.15 - 10.30	**Regards of the International Authorities (M. Bricelj, Slovenian Presidency of the Alpine Convention, Slovenia; M. Onida, Secretary General, Permanent Secretariat of the Alpine Convention) and opening of the works (P. Angelini, Italian Ministry for the Environment, Land and Sea, Italy)**

1st session "The hydrogeological risk in the alpine environments"

10.30 - 13.20 **(chairman: A. Armanini, University of Trento - CUDAM, Italy;** presentation of the 1st Workshop's outcomes**: F. Dellagiacoma, Province of Trento, Italy)**

10.45 - 11.05	Natural hazards in the alpine environment (P. Greminger, PLANALP – Platform Natural Hazards, Switzerland)
11.05 - 11.25	Hazards and risk aspects on the Upper Adriatic river basins (R. Casarin - F. Giuriato, Upper Adriatic river basin authority, Italy)
11.25 - 11.45	Delocalization of settlements: extreme intervention or priority (M. Carraro, A. Baglioni, Veneto Region, Italy)
11.45 - 12.00	**Coffee break**
12.00 - 12.20	Comparison of the legal framework on the evaluation and management of natural hazards (E. Vittori, ISPRA – Institute for Environmental Protection and Research, Italy)
12.20 - 12.40	Strategies for flood control: our answers for future challenges (E. Eichenseer, Bavarian State Ministry of the Environment and Public Health, Germany)
12.40 - 13.00	Debris flows in alpine areas (A. Armanini, University of Trento, Italy)
13.00 - 13.20	Discussion

13.00 - 13.40 **Press conference**

13.20 - 14.30 **Lunch break**

14.30 - 17.45 **2nd session "River Basin Management Plans as an instrument for the safeguard of the alpine mountain ecosystem" (chairman: L. Füreder, University of Innsbruck, Austria;** presentation of the 2nd Workshop's outcomes**: P. Mancin, Region Piemonte, Italy)**

14.45 - 15.05	Alpine specific issues of River Basin Management Plans in Alpine Countries - review of the Platform "Water Management in the Alps" of the Alpine Convention (R. Imhof, Vice Secretary General, Permanent Secretariat of the Alpine Convention)
15.05 - 15.25	Climate change in the Alps and the impacts on water resources (S. Isoard, EEA - European Environment Agency)
15.25 - 15.45	River basin management plans: opportunities for an integrated approach to the water management (F. Puma, Po river basin authority, Italy)
15.45 - 16.05	The Alps as a pilot - area for water governance (N. Evrard, Association Européenne des Elus de Montagne, France)
16.05 - 16.20	**Coffee break**
16.20 - 16.40	The conflicts in the uses of water resources: economic and social aspects (J. Mysiak, FEEM – Fondazione Eni Enrico Mattei, Italy)
16.40 - 17.00	Comparison of the legal framework: from European to local level (G. Pineschi, Italian Ministry for the Environment, Land and Sea, Italy)
17.00 - 17.20	The River Basin Management Plans for the conservation and the restoration of the river alpine ecosystems (A. Goltara, CIRF – Italian Center for the River Restoration, Italy)
17.20 . 17.40	Artificial snowmaking: economical, social and environmental aspects (P. Paccard, University of Savoy, France)
17.40 - 18.00	Discussion

Day 2 (Friday, 26 November 2010)

09.30 -12.30 **3rd session "The hydroelectric production in the Alps"**

1st part: "The hydroelectric production in the Alps: ecological, economic and social aspects" (chairman and presentation of the 3rd Workshop's outcomes**: P. Colonna, Platform Water Management in the Alpine Space, Italy)**

09.45 - 10.05	The hydropower generation in the Alps and future trends (K. Schwaiger, Platform Water Management in the Alpine Space, Austria)
10.05 - 10.25	Landscape issues related to hydropower generation (M. Sargolini, University of Camerino, Italy)
10.25 - 10.45	The regulatory framework and the market for renewable energy, incentives in the field of hydroelectric power and impacts on the development of Alpine economy (G. Pineschi, Italian Ministry for the Environment, Land and Sea, Italy)
10.45 - 11.05	Economic assessment on the hydropower use in alpine environment (A. Massarutto, Bocconi – IEFE, University of Udine, Italy)
11.05 - 11.20	Discussion
11.20 - 11.35	**Coffee break**

2nd part: The "Common Guidelines for the use of Small Hydropower in the Alpine Region" by the Water Platform (chairman: F. Puma, Po river basin authority, Italy)

11.40 - 11.55	Presentation of the draft of the Guidelines (M. Pfaundler, Platform Water Management in the Alpine Space, Switzerland)
11.55 - 12.05	The point of view of the producers (S. Gollessi, ESHA, Belgium)
12.05 - 12.15	The point of view of NGOs (L. Dagostin, Club Arc Alpin, Austria)

	12.15 - 12.25	The point of view of ArgeAlp (F. Zanon, Work Community ArgeAlp)
	12.25 - 12.35	The point of view of local authorities (A. Rodondi, Province of Sondrio, Italy)
	12.35 - 13.00	Discussion
13.00 - 14.15	**Lunch break**	
14.15 - 16.00	**Panel discussion and conclusions**	

This volume is intended to offer to public administrations and other stakeholders involved in the infinite subject of water management in mountainous regions an up-to-date collection of theoretical knowledge, policies and experiences implemented with this respect in the Alps.

The publication originates from the "Alpine Water Conference 2010 - 3rd International Conference on Water in the Alps" and its three preparatory workshops, which were organized by the Italian Ministry for the Environment, Land and Sea in accordance with the Decision of the X Alpine Conference. This was the occasion to gather experts, technicians and political representatives together to discuss on water management in the alpine territory. Their contributions are presented in this publication, which was promoted by the Italian Ministry for the Environment, with the support of the Alpine Convention, the Piedmont Region, the Autonomous Province of Trento and the Province of Sondrio for the contents development. Three main sections and two annexes compose this volume.

The first section deals with water planning at the river basin level and the management of the related natural hazards, the second focuses on water as an important element of the vulnerable mountain ecosystems needing protection, and the third investigates the economic value of water used for hydropower generation.
Water may be an asset or a risk for mountain territories, that's why people who bear responsibility over the matter are asked to wisely manage this precious natural resource. This publication aims to give an original contribution on the matter.

Tiree FOUNDATION

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