Synthetic report on project results in terms of economic valorisation of ecosystem services

AIM Project contribution to a balance development of hydropower and conservation of good quality of water in the Alps

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In the framework of the Alpine space program, a project called Alpine Space In Movement (AIM) has aimed to capitalise several other projects and cooperation experiences about the compatibility of renewable energy development (in particular hydropower) and conservation of ecosystems (in particular water ecosystems). The question of valorisation of ecosystem services is one of the leading question about conservation of natural resources. This report is not a scientific analysis; it would like to be consider as an Alpine contribution to a European political debate on how to sustainably mix adaptation to climate change and biodiversity protection.

This contribution is a synthesis of various points-of-view and documents coming from the United nations organisations, the European Commission and several scientific works. It aims to give some keys to read and understand the context, but also some references to set up in the framework of the up-coming macroregional strategy for the Alps, EUSALP, with the support of the Alpine space program and the Alpine Convention, an integrated strategy of river ecosystem conservation and hydropower sustainable development.

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1. What is the economic valorisation of ecosystem services?

TEEB / Principles of the Economics of Ecosystem and Biodiversity

- The economic benefit of biodiversity
- The integration of ES in Public policies
- The integration of ES in market place
- The payment for water ecosystem services

2. How to valorise water ecosystem and develop sustainable energy?

- The nexus energy-water in the Alps
- Societal opportunities and challenges
- Cross-cutting issues
- Water and energy sustainability

3. Experiences and proposals from projects and cooperations

AIM / SESAMO : a bridge between a market production (energy) and a general interest good (water)

- MCA a support for decision making
- SHARE –SESAMO: The current challenges require that the energy sector addresses the complex hydrological aspects. There is also a solid economic case as integrating energy and water generates an array of benefits to society by increasing welfare, reducing poverty and sharing prosperity
- Energetic valuation of ecosystem services

C: The Alps a leading region in Europe for water and energy

Introduction

How to combine adaptation to climate change which would engage innovation and development of production of renewable energies and an ambitious and vital conservation of biodiversity? This evident paradox is a crosscutting issue that is strongly present in the *a priori* opposition between renewable hydropower production and water quality. The Alps as a major area of hydropower production in Europe and as the main water-tower of Europe is deeply concerned by this contradiction that orthodox and partial analyses are carrying.

Some European policies and sectorial approaches have difficulties to face this challenge. An evident symbol is to face the incompatibility between E-RES directive and Water Framework directive.

But solutions exist.

On one hand, it is necessary to internalize the externalities, to modify market valuation to give more consideration to ecosystems. The notion of Ecosystem services is an important innovation that helps to give a value to biodiversity. The work done in the frame of the Millennium assessment about the economic valorisation of ecosystem services is one of main most motivating work done at global level between scientists, decision makers and operational actors. It opens new perspectives.

On second hand, energy could be used as one commune denominator. By the way, energy has a price and a market.

There are methods to integer the environmental value of ecosystems and the economic value of energy. The necessity to develop renewable energies that should be define also throw this integration of their environmental value, is urging this connexion. AIM project by trying to support decision makers and engineers to get a fair compatibility between hydropower and quality of river ecosystem, opens new debate and arises new possibilities in public policies field on the crucial challenge.

Millennium Assessment

The Millennium Ecosystem Assessment (MA) was called for by the United Nations Secretary-General Kofi Annan in 2000. Initiated in 2001, the objective of the MA was to assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being. The MA has involved the work of more than 1,360 experts worldwide. Their findings, contained in five technical volumes and six synthesis reports, provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide (such as clean water, food, forest products, flood control, and natural resources) and the options to restore, conserve or enhance the sustainable use of ecosystems.

1. What is the economic valorisation of ecosystem services?

TEEB / Principles of the Economics of Ecosystem and Biodiversity

The economic benefit of biodiversity

The Economics of Ecosystems and Biodiversity (TEEB)[1] is a global initiative focused on drawing attention to the economic benefits of biodiversity including the growing cost of biodiversity loss and ecosystem degradation.

The TEEB initiative presents an approach that can help decision-makers recognize, demonstrate and capture the values of ecosystem services and biodiversity.

The TEEB study is underpinned by an assessment of state-of-the-art science and economics. The goal of TEEB Ecological and Economic Foundations is to provide the conceptual foundation to link economics and ecology, to highlight the relationship between biodiversity and ecosystem services and to show their importance for human well-being. Written by a team of international experts and led by Dr. Pushpam Kumar, this aspect of the TEEB study tackles the challenges of valuing ecosystem services, as well as issues related to economic discounting. It aims to quantify the costs of inaction and examine the macroeconomic dimension of ecosystem services loss. This information will focus on improving our understanding of the economic costs of biodiversity loss and ecosystem degradation.

Examples include water and air quality regulation, nutrient cycling and decomposition, plant pollination and flood control, all of which are dependent on biodiversity. They are predominantly public goods with limited or no markets and do not command any price in the conventional economic system, so their loss is often not detected and continues unaddressed and unabated. This in turn not only impacts human well-being, but also seriously undermines the sustainability of the economic system.

TEEB Ecological and Economic Foundations is the most comprehensive overview of existing thinking in this area to date, and the process is bringing scientists and economists together to provide the analysis and tools required in order for us to be able to create a robust methodological framework enabling the decision-makers at different levels to undertake economic analysis of ecosystem services and biodiversity.

Human well-being is dependent upon "ecosystem services" provided by nature for free. Such services include water provision, air purification, fisheries, timber production and nutrient cycling to name a few. These are predominantly public goods with no markets and no prices, so their loss often is not detected by our current economic incentive system and can thus continues unabated. A

[1] http://www.teebweb.org/

variety of pressures resulting from population growth, changing diets, urbanisation, climate change and many other factors is causing biodiversity to decline. As a result, ecosystems are continuously being degraded. The world's poor are most at risk from the continuing loss of biodiversity, as they are the ones that are most reliant on the ecosystem services that are being degraded.

The TEEB initiative was launched in response to a proposal by the G8+5 Environment Ministers (Potsdam, Germany 2007) to develop a global study on the economics of biodiversity loss. The European Commission has been a strong supporter of TEEB from the start and one of the initiative's largest donors.

The TEEB study evaluates the costs of the loss of biodiversity and the associated decline in ecosystem services worldwide, and compares them with the costs of effective conservation and sustainable use. It intends to raise awareness of the value of biodiversity and ecosystem services and to facilitate the development of cost-effective policy responses and better informed decisions.

TEEB has been conducted in three main phases.

Phase 1) Preliminary findings from the first phase were presented at the High-Level Segment of the Ninth Conference of the Parties to the Convention on Biological Diversity (CBD COP-9) in Bonn, Germany, in May 2008, in the form of an interim report[2].

Phase 2) The second, more substantial, phase of the study produced one background report and several reports targeted towards specific categories of decision makers who are also potential users of evaluation tools for biodiversity and ecosystem services:

- TEEB Ecological and Economic Foundations.
- TEEB for National and International Policy Makers
- TEEB for Local and Regional Policy
- TEEB for Business
- TEEB Synthesis Report

The final results of these reports were presented at CBD COP-10 in 2010. On 13 November 2009, the Report for Policy Makers was released in Brussels[3]. The Report for policymakers is the TEEB output most directly connected to the political agenda and aimed at better integrating biodiversity priorities into policy choices.

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[2] **THE ECONOMICS OF ECOSYSTEMS AND BIODIVERISTY - Interim Report 2008** http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/teeb_report.pdf

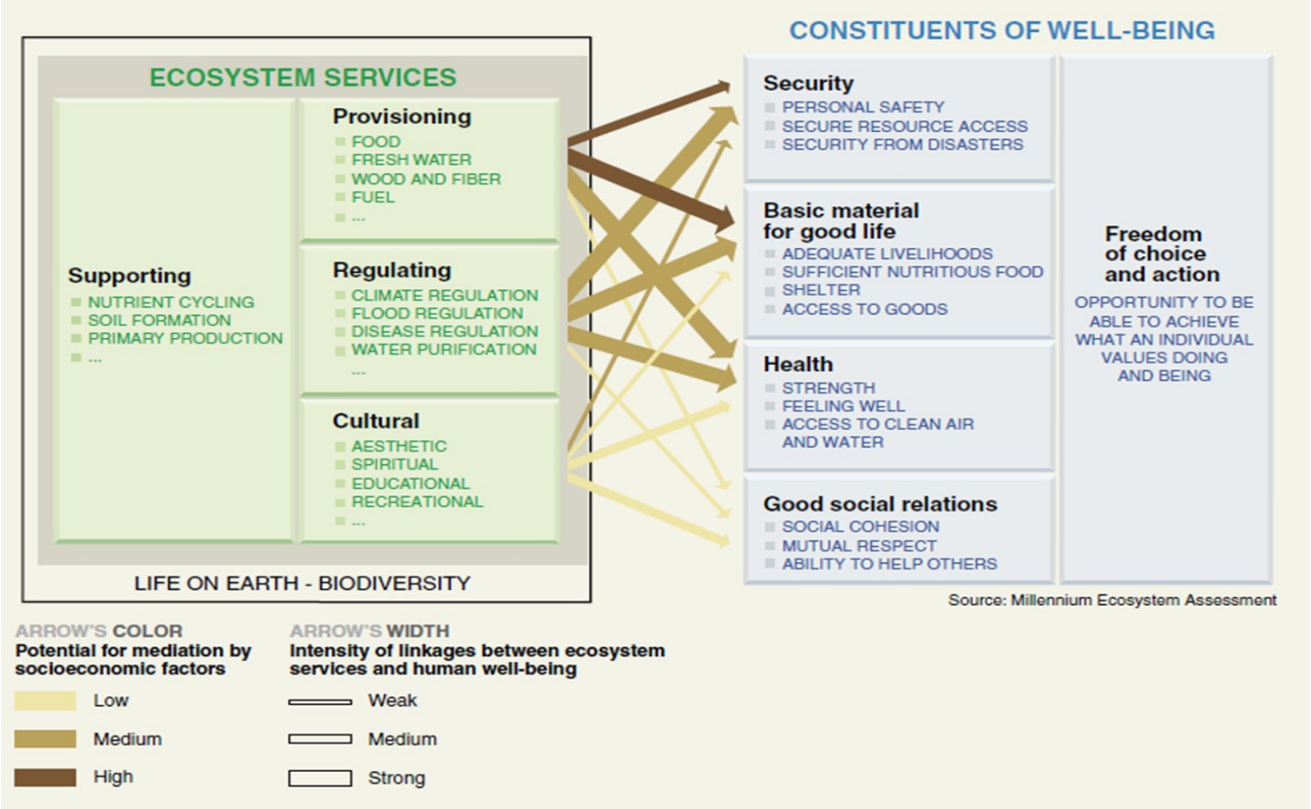
[3] See the press release of UNEP and the EU press release. The full D1 report is available here. Please go to the TEEB website to view the other reports.

In particular, the Executive Summary of THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY Report for Policy Makers should be read as a key contribution for future policy making.

Phase 3) The focus of phase III is on communication and outreach activities, on supporting TEEB national and sectoral studies inspired by the TEEB reports and on maintaining the TEEB network of experts.

The European Commission has contributed to TEEB Phase III through financing the project 'TEEB National Implementation: Reflecting the Value of Ecosystems and Biodiversity in Policymaking", which is implemented by UNEP. The project aims to implement TEEB in five developing countries, and was launched in Hyderabad at CBD CoP-11. One of the project deliverables is a Guidance Manual to support national TEEB implementations.

Additionally, a European Commission study was completed in the context of TEEB. It is designed to support EU Member States in taking forward action 5 of the EU Biodiversity Strategy, which aims to 'improve knowledge of ecosystems and their services in the EU'; "Member States, with the assistance of the Commission, will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020."[4]



[4] A synthesis of approaches to assess and value ecosystem services in the EU in the context of TEEB

The integration of ES in Public policies

As part of good governance, decision-making affecting people and using public funds needs to be objective, balanced and transparent. Access to the right information at the right time is fundamental to coherent policy trade-offs. Better understanding and quantitative measurement of biodiversity and ecosystem values to support integrated policy assessments are a core part of the long-term solution.

There is of a wide disparity across MS in terms of the stage of development of national ecosystem service assessments.

There are currently a large number of TEEB inspired national assessment in the early stages of development and implementation. A few Member States have already completed extensive national assessments that include valuation of ES, the one conducted in the UK being the most comprehensive one, followed by Ireland (biodiversity) and the Czech Republic (grasslands), while most are at (very) early stages of development of national assessments (e.g. Germany, Poland, Austria, Belgium, Netherlands, Norway) and others have no on-going national assessment (e.g. Sweden, Romania, Italy). These initiatives are expected to deliver results over the coming 1-3 years.

From the set of completed national assessments, several observations can be made.

Regarding the coverage of ecosystems they address, there has generally been a focus on terrestrial ecosystems. Marine ecosystem services are relatively less well explored. In terms of the categorisation of ES, a common classification has not been used. Instead, each national assessment has made its own adaptations of existing classifications (e.g. MA and TEEB), and in some MS discussions about the exact definition of ES are still ongoing (e.g. Germany).

Regarding this European orientations, various Alpine member states have initiate some actions toward the Green economy. For example, in Italy, a recent law set up environmental accounting: and create a Committee for natural capital. The objective is that environmental issues enter fully into economic decision-making and financial of the country. Is established fact, at no cost to government spending, the Committee for natural capital with the aim of integrating environmental costs in the process of preparation of the Document of Economics and Finance (Def) and other acts of government in matters of financial planning and budget. The Committee will provide the government the tools for better understanding of the effects of the state of natural resources and the environment, on the economic performance of the country and the well-being of individuals, in particular identifying the economic and social consequences arising from the failure to prevent the impacts and environmental damage of productive activities. By 28 February each year, the Committee delivered to the President of the Council of Ministers and the Minister of Economy and Finance a report on the state of the natural capital of the

country, accompanied by the information and environmental data expressed in physical units and monetary following the methodologies defined by the United Nations and the European Union.[5].

French government, members of Parliament and policy makers are also working on the integration of ecosystem services as indicators to define public the amount dotation for local authorities.

The work done throw TEEB gives structuring elements that could be adapted at the Alpine space level.

THE OPPORTUNITY: THE VALUE OF NATURE FOR LOCAL DEVELOPMENT

All economic activity and most of human well-being is based on a healthy, functioning environment. By focussing on the various benefits from nature – ecosystem services – we can see more clearly the direct and indirect ways that human well-being depends on the natural environment. Nature's benefits are multiple and include all our food; our water; safe places for living; materials such as timber, wool and cotton; and many of our medicines. Healthy natural systems regulate our climate, protect against hazards, meet energy needs, prevent soil erosion, and offer opportunities for breath-taking recreation, cultural inspiration and spiritual fulfilment.

For local development, considering ecosystem services in policy making can help save on future municipal costs, boost local economies, enhance quality of life and secure livelihoods. This approach also helps tackle poverty as it discloses the distribution of scarce and essential resources and services upon which people depend.

So far, nature's benefits have played a minor role in policy. Policies and public investments for a functioning environment are often considered a luxury rather than life insurance. Why is this the case? It is largely due to the fact that many ecosystem services are poorly visible and their continuous availability is often falsely assumed.

Also, many of nature's benefits are public goods – such as pollination – belonging to all, so there is little incentive to take action on behalf of 'everyone'. Finally, other needs and objectives may seem more pressing and desirable and decisions are often made without knowing the environmental consequences.

This is a problem because our natural capital is diminishing. Wasteful use of resources and limited concern for natural systems drive its loss. Ecosystems have their tipping points. After this point, restoration or seeking alternatives for benefits lost, can consume considerable time, money and effort. It takes years for a replanted mangrove belt to provide effective coastal protection again. While many pressures are beyond the local scope, local policy makers still have to deal with their consequences.

[5] See more at: http://www.minambiente.it/comunicati/cdm-approva-collegato-ambientale-lagenda-verde-del-governo#sthash.tQGM44CN.dpuf

TEEB suggests a shift in focus. Economic analysis indicates that maintaining healthy ecosystems is often a better, less expensive, option. Appraising ecosystem services provides a full picture, outlining the costs and benefits of different policy options and highlighting the best local strategy for enhancing human well-being and economic sustainability.

THE TOOLS: APPRAISING ECOSYSTEM SERVICES

When appraising nature's benefits we should seek answers to these questions:

Which ecosystem services are central to my local/regional society and economy? Who depends on these services? Which services are at risk? How will a policy action affect these services? Local knowledge and dialogue among colleagues and stakeholders can generate first answers that help orient policy.

This report provides a hands-on overview of frameworks for considering nature. These frameworks structure our take on nature in economic, ecological or developmental terms. On that basis, different tools allow for appraising and valuing ecosystem services. Qualitative tools describe the connections between ecosystem services and human well-being. They also capture the appreciation people attach to nature's benefits. Quantitative tools examine amounts, intensities and impacts of different ecosystem services.

Monetary tools attach monetary values to both the presence and loss of ecosystem services.

The report also introduces three decision support methods by which appraisal and valuation of ecosystem services can directly inform policy choices: cost-benefit analysis, participatory appraisal and multi-criteria analysis. The strengths, weaknesses and requirements of each are discussed.

TEEB's stepwise approach

A stepwise approach helps navigate through the different assessment options available. This approach is not a fixed recipe, but is intended to guide policy makers in designing their own processes for appraising and considering nature's benefits in their policy decisions:

(i) Specify and agree the policy issue with stakeholders to avoid misunderstandings during decision making and implementation.

(ii) Identify which ecosystem services are most relevant to the policy issue in order to focus analysis.

(iii) Define the information needs to tackle your issue and select appropriate methods for assessment.

(iv)Assess ecosystem services, expected changes in their availability and distribution.

(v) Identify and appraise policy options based on your assessment.

(vi)Assess distributional impacts of policy options on different groups in your community.

THE PRACTICE: ECOSYSTEM SERVICES IN POLICY AND MANAGEMENT

Knowing their natural capital and the services it provides can help local policy makers in rural and urban management, in spatial planning, and in protected areas management. It allows to refine government regulations and to develop market-based instruments. This report explores reasons for and examples of applying a focus on nature's benefits in these local policy areas.

Cities depend on nature. Ecosystem services can provide cost-effective solutions to municipal services, such as wastewater treatment by wetlands. City managers can enhance the flow and benefits of ecosystem services by influencing modes of production, procurement and creating incentives.

In rural development, we often promote ecosystem services with high market value to the detriment of regulating services that are equally important, but less obvious. Local officials play a key role in implementing, adjusting and informing sustainable practices in forestry, fisheries, agriculture and tourism.

Planning frameworks and environmental impact assessments can proactively include ecosystem services. This allows the identification of economic potentials, rather than simply identifying constraints.

Protected areas can be an important local as well as national asset. To enhance local benefits, protected areas need to be connected with the management of the surrounding landscape. A focus on ecosystem services is instrumental in zoning, management and fundraising.

Locally adapted payment schemes for ecosystem services, as well as certification and labelling, can reward good stewardship of natural capital. What works well in theory may be demanding in practice. A successful market-based instrument should build on transparent, credible governance and incorporate effective monitoring and enforcement.

THE LESSONS: HOW TO MAKE IT HAPPEN

Three issues, beyond the appraisal of ecosystem services itself, need attention if you wish to make natural capital work for local development:

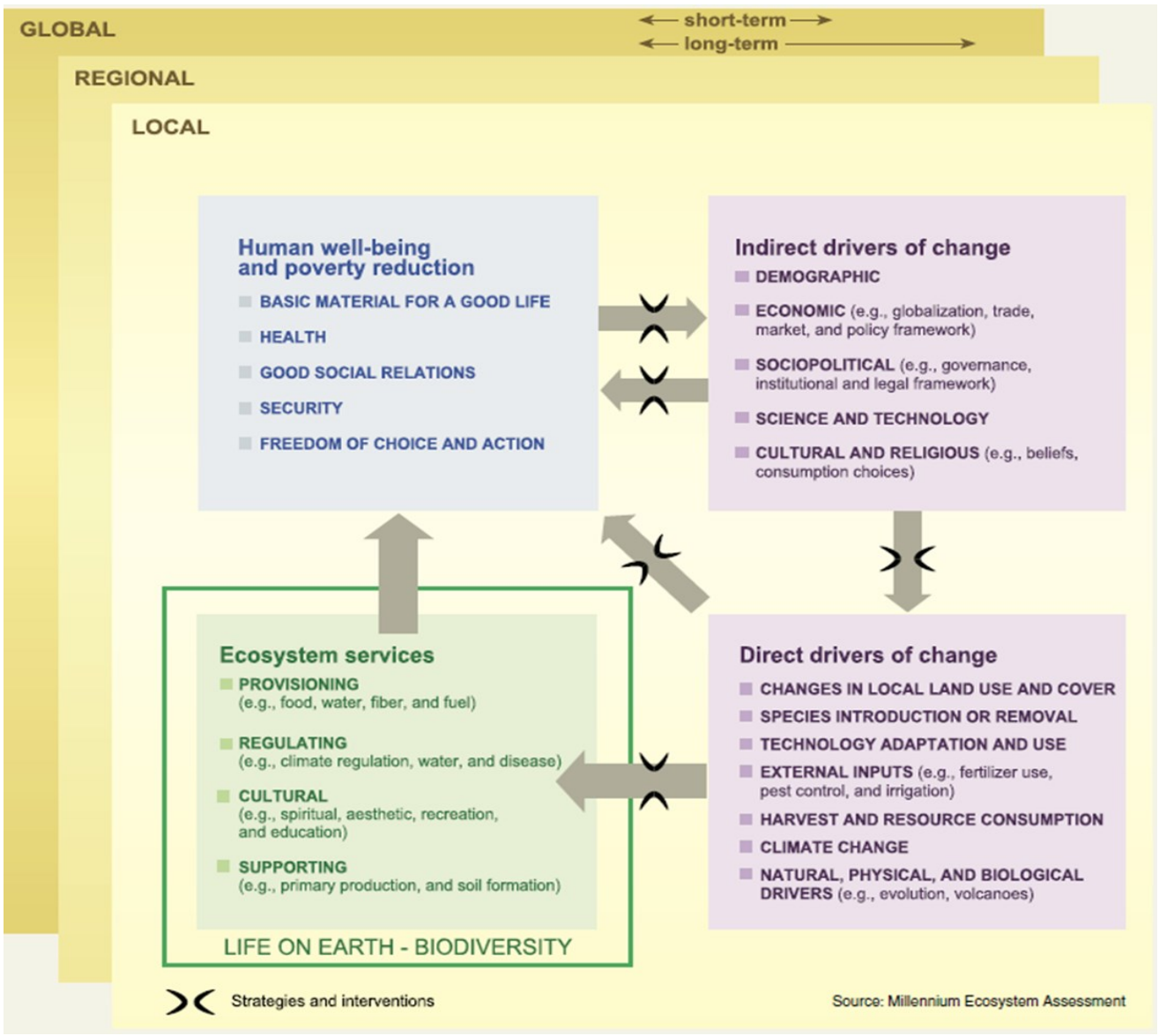
(i) The distribution of rights to nature's benefits. Policy changes often affect service distribution or access and this needs to be considered during decision making.

(ii) The optimal use of available scientific and experience based knowledge. The ecosystem services framework provides a common language to capture diverse views.

(iii) Well-informed facilitation of participatory processes. Stakeholder engagement is needed to bring all these facets together, to prioritize and to develop feasible and effective local policy action.

This report is to be treated as a catalyst for further thinking – a starting point for adopting ways to make your natural capital flourish. In addition to the examples used in this report hosts a collection of more than 100 short case studies which illustrate a focus on ecosystem services in diverse settings.[6]

[6] http://doc.teebweb.org/wp-content/uploads/Study%20and%20Reports/Reports/Local%20and%20Regional%20Policy%20Makers/D2%20Report/TEEB_Local_Policy-Makers_Report.pdf


GLOBAL
short-term
long-term
REGIONAL
LOCAL
Human well-being and poverty reduction
BASIC MATERIAL FOR A GOOD LIFE
HEALTH
GOOD SOCIAL RELATIONS
SECURITY
FREEDOM OF CHOICE AND ACTION
Indirect drivers of change
DEMOGRAPHIC
ECONOMIC (e.g., globalization, trade, market, and policy framework)
SOCIOPOLITICAL (e.g., governance, institutional and legal framework)
SCIENCE AND TECHNOLOGY
CULTURAL AND RELIGIOUS (e.g., beliefs, consumption choices)
Ecosystem services
PROVISIONING (e.g., food, water, fiber, and fuel)
REGULATING (e.g., climate regulation, water, and disease)
CULTURAL (e.g., spiritual, aesthetic, recreation, and education)
SUPPORTING (e.g., primary production, and soil formation)
LIFE ON EARTH - BIODIVERSITY
Direct drivers of change
CHANGES IN LOCAL LAND USE AND COVER
SPECIES INTRODUCTION OR REMOVAL
TECHNOLOGY ADAPTATION AND USE
EXTERNAL INPUTS (e.g., fertilizer use, pest control, and irrigation)
HARVEST AND RESOURCE CONSUMPTION
CLIMATE CHANGE
NATURAL, PHYSICAL, AND BIOLOGICAL DRIVERS (e.g., evolution, volcanoes)
Strategies and interventions
Source: Millennium Ecosystem Assessment

The integration of Biodiversity and Ecosystem Services in Business decision making

Business and industry have also a key role to play in supporting the development, delivery and implementation of these outcomes defined from the UN Conference on Sustainable Development (Rio+20) in June 2012.

While improving the triple bottom line –the environment, social and economic pillars of a companies' performance– is now embedded in many companies' philosophy, there is still more work to be done.

Lessons already learnt

There is a growing understanding and awareness of the impact and reliance that many business operations have on biodiversity and ecosystem services. We have learnt over the years that this reliance can translate into risks to business in a variety of ways.

For example, negative impacts on biodiversity and ecosystem services can affect business operational costs and decrease profit margins.

Failure to understand and manage business impacts on biodiversity and ecosystem services can lead to issues of liability and redress, affect company reputation, and impede future access to credit, land and markets.

One of the key lessons learnt over the past 20 years is that many businesses need guidance and support to further their understanding of how their operations impact on biodiversity and ecosystem services. Support is required to encourage integration of biodiversity and ecosystem services elements into business planning, corporate reporting, and accounting frameworks.

Benefits that could be gained strong understanding and awareness of the interrelationship between biodiversity, ecosystem services and business operations can lead to new business opportunities as demandgrows for more efficient and newways to use natural resources.

Many leading businesses are seeking to incorporate biodiversity and ecosystem services considerations into their investment decisions, the design and implementation of their business practices and their supply chain management systems.

Some of the benefits from this include:

o Compliance with global commitments and alignment with the emerging international policy decisions

o Improved transparency in impacts of business operations which can help strengthen investor confidence

o Opportunity to identify and reduce environmental impacts and address unsustainable production patterns

o Strengthen ed market ability for corporate social responsibility which could lead to enhanced company reputation

Practical experience from UNEP-WCMC

UNEP-WCMC has a wide range of experience working with, and providing tools for, business and industry to improve corporate understanding and awareness of the importance of biodiversity and ecosystem services to their business operations.

Some key examples include:

O The Proteus Partnership : a unique collaboration between major extractives and UNEP-WCMC, supported by technology partners, aimed at making data and information on biodiversity available for businesses to improve their environmental practices. A registered partnership of Rio +10 and Rio+20, the Proteus Partnership has successfully improved the accuracy of information on the world's protected areas; provided integrated access to spatial data on threatened species and other important biodiversity; and increased access to quality data on coastal and marine ecosystems to help improve decision-making for the extractives sector

O The Integrated Biodiversity Assessment Tool (IBAT): an innovative decision support tool that compiles biodiversity data through a centralized mapping tool to enable businesses to review and assess biodiversity considerations that may affect proposed investments, future developments and existing operations

O Indicators on biodiversity and ecosystem services for business performance disclosure: UNEP – WCMC recently produced a report in conjunction with theGlobal Reporting Initiative and CREM, An Approach for Reporting on Ecosystem Services: Incorporating Ecosystem Services into an Organization's Performance Disclosure, which proposes indicators that organisations could use to assess and report their impacts on ecosystem services. This type of work will be instrumental in assisting companies to understand how their business actions and decisions interact with, and impact on, biodiversity and ecosystems.

Biodiversity and market-based instruments: UNEP-WCMC has supported work to review implications for business and industry arising from biodiversity and ecosystem services valuation . This type of work will assist companies to assess the level of risks they face

O Biodiversity and Ecosystem services criteria in standards:

UNEP-WCMC has been working with partners to strengthen biodiversity criteria in standards and certification schemes and will undertake further work to review and assess the level of inclusion of

ecosystems services, and explore opportunities for developing best practice guidelines for inclusion of such criteria in these schemes.

Making progress

Outcomes from Rio+20 has contained a variety of commitments and obligations that will require implementation by a range of stakeholders including business and industry.

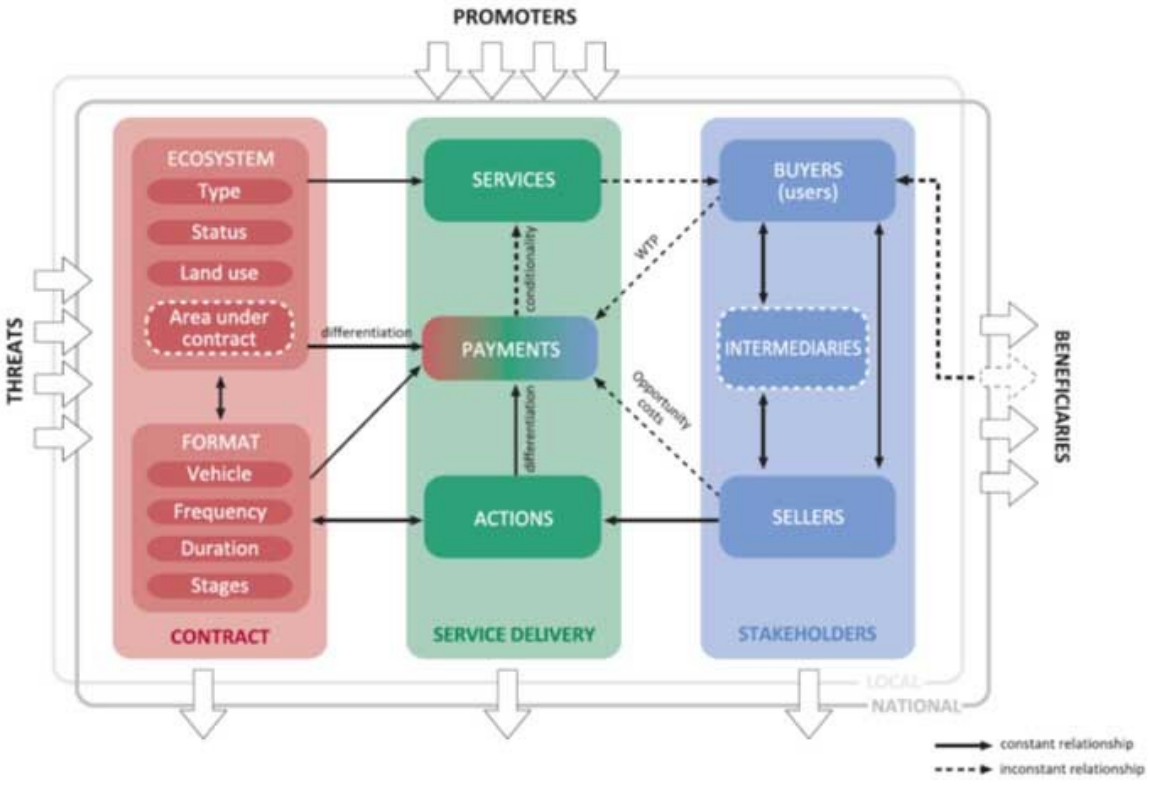
Possible steps towards supporting integration of biodiversity and ecosystem services into business decision-making include:

O Development of a roadmap to improve uptake and transparency of corporate sustainability reporting that includees requirements to report on impacts on biodiversity and ecosystems services

O Dissemination of tools available to support business and industry understanding of how to monitor and assess potential and current impacts of their operations on biodiversity and ecosystem services

These orientations could find a pilot dimension throw the Alpine space area.

Payment for water ecosystem services



Payment for Ecosystem Services (PES) schemes are attracting increasing interest as policy mechanisms to improve conservation and achieve sustainable development outcomes. Regarding the strategic challenge and asset of biodiversity in mountain area, AEM is investigating for years the use of PES in relation to natural resources as water and to energy. PES initiatives aim to reach mutually beneficial agreements between providers and users of ecosystem services, entailing a reward mechanism for ecosystem managers for maintaining or improving the provision of the services valued by beneficiaries.

2. How to valorise water ecosystem and to develop renewable energy?

The nexus energy-water in the Alps is fundamental.

More than elsewhere in Europe, energy and water are inextricably linked - we need "water for energy" and we need "energy for water". Without energy and water we cannot satisfy basic human needs, produce food for a rapidly growing population and achieve economic growth. Water and energy are both the main issues considering the relationships between mountains and metropolises located in the piedmont alpine area: are we looking for mutual solidarity or do we organize an unbalanced exchange between the two majors territorial components of the Alpine region.

This important issue for the Alps seems at global level even more sensitive and vital. Several years ago, in the Asia-Pacific Water Development Outlook 2007, the Prime Minister of India stated that "...if all members of society can have adequate access to energy and water, many of the societal problems can be solved". That statement is as true today as it was then. Energy and water are inextricably linked– we need "water for energy" for cooling, storage, biofuels, hydropower, fracking etc., and we need "energy for water" to pump, treat and desalinate. Without energy and water we cannot satisfy basic human needs, produce food for a rapidly growing population and achieve economic growth. And yet, today, 1.3 billion people lack access to electricity and some 800 million people get their water from unimproved sources. Many more consume water that is unsafe to drink. These are mostly the same billion poor, hungry and underprivileged human beings. Over the coming 30 years food and energy demands are expected to increase dramatically, yet we will depend on the same finite and vulnerable water resource as today for sustaining life, economic growth and our environment.

The approach made by AIM project proposes to take an overall "systems view" of how we develop and manage energy and water for the good of society and ecosystems – at local, national, regional and global levels – and avoid unintended consequences of narrow sectoral approaches. The "water, energy [and food] security nexus", underpinning the green growth approach, is central to the project agenda.

The energy and water theme could be addressed from two overall perspectives: the societal opportunities and challenges, and the cross-cutting issues.

Societal opportunities and challenges

Demography and economy driving energy and water demands efficient production and use of energy and water is essential in the trans-national context to ensure basic needs and development

opportunities for people. However, both energy and water transcend national boundaries, physically through transboundary waters and power grids, and economically through regional economic cooperation. Cooperation between nations and regions increasingly focuses on sharing benefits, rather than water per se, with both food and energy as the primary, water-dependent goods to share.

At the global level recurrent crises – energy, food, financial – illustrate systemic inter-dependence. Developing countries have serious challenges in achieving the Millennium Development Goals (MDGs) by 2015, and the close water, energy, and food interconnections need to be considered in formulating Sustainable Development Goals (SDGs) to follow the MDGs from 2015.

Balancing societal uses of energy and water

Energy and water are critical factors in urban development. Rapidly growing cities depend on reliable energy and water supply, but must try to reduce demands, manage trade-offs and optimise resource use by reuse, recycling and generation of energy from waste, all in an integrated urban management context. For industrial development improved efficiency in the use, and reuse, of energy and water is essential to save on increasingly scarce resources and costs, for both production and waste management. An added driver is to strengthen corporate social and environmental responsibility through sustainable production. Research, innovation and technology development for improved energy and water efficiency are essential for such efforts. The energy-water linkage is not only about quantity, but also about water quality and pollution, related to pollutant discharge, to significant quantities of heated cooling water affecting surface waters, or to potential groundwater pollution due to energy-related geo-engineering activities, including fracking.

Energy and water in a vulnerable and changing environment. Sharply accelerating demands for food and energy production place increasing pressure on the availability of water for vulnerable ecosystems and the biodiversity and human livelihoods they sustain. Energy production, be it hydropower development, biofuel production, shale gas exploitation or other forms of energy production, may have serious environmental and social consequences that need to be properly assessed and addressed.

Climate change may affect the water system through increased variability, long term temperature and water balance changes and sea level rise, and is in many cases an added driver to be considered. Climate adaptation is primarily about water and land, but water resources are also critical for climate change mitigation, as many efforts to reduce carbon emissions rely on water availability. Because the water cycle is so sensitive to climate change, and because water is so vital to energy generation and carbon storage, we need to recognise the coherence between mitigation and adaptation measures. In ensuring this, and managing variability and environmental flow requirements, storage of both energy and water becomes a critical issue, including water as a

medium for storing energy. Storage may be required at all levels, from the household and village levels to major infrastructure in transboundary settings, not least in developing countries. Such storage may be provided through investments in conventional infrastructure and/or in the restoration and management of natural systems.

Cross-cutting issues

Coordinating energy and water policies and governance

Unintended consequences of energy development for water, and vice versa, often have their roots in fragmented policies, e.g. energy subsidies in some parts of the world contributing to unsustainable groundwater overdraft through excessive pumping.

The energy and water worlds seem to be divided between those who focus on technical solutions, and those who assume that the challenge is rather one of politics and governance. In taking a "systems view" energy and water policies need to be coordinated.

In developing effective energy and water governance different characteristics and traditions prevail: while energy production most often is centrally managed, good water governance needs to include local, de-centralised planning and management in dialogue with affected stakeholders. For both, top-down needs to meet bottom-up governance. As evident when addressing the water, energy and food security linkages, real engagement of actors from other sectors is a pre-condition for success. For water the implementation of the Integrated Water Resources Management (IWRM) approach includes energy, but its role has not been sufficiently examined. In the energy sector policy choices, whether conventional or alternative, must depend on water resources availability and vulnerability. Both require stakeholder involvement in the entire chain from resource exploitation through regulation to consumption, including consideration of both energy and water in the food chain from "field to fork".

Poor and vulnerable stakeholders in developing countries require special attention, as does improved gender equality and youth participation.

Addressing the economic and financial aspects of water and energy the economic value of energy varies in a changing market and may be difficult to assess for long term investments. For water, assessments of economic value must accommodate the fact that water is a public and social good, and access to safe drinking water has been declared a human right by the United Nations.

At the same time, assessment of costs and benefits for different water uses needs to address gaps in knowledge of values linked to biodiversity and ecosystem services. However, when addressing benefit sharing, and likely energy and water markets, not least across boundaries, acceptable and reliable estimates are required.

When it comes to financing and pricing the situation is equally complicated, due to the asymmetry, volatility and inter-linkages of energy and water prices, with energy mainly being priced on the

market and water as a public good. Understanding of these inter-linkages, and their economic and financial implications, are necessary for both public and private decision-makers.

Developing information and decision support systems for energy and water

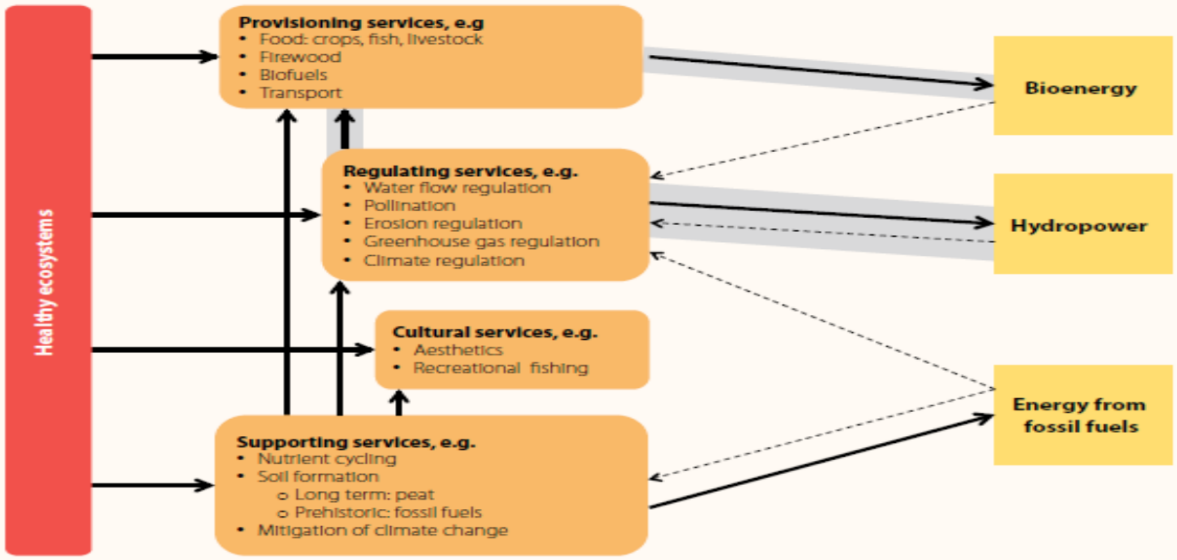
Access to, and sharing of data and information, not least across jurisdictions and boundaries, is in itself a major challenge for water resources management. In transboundary settings it is often considered an issue of national security. The data and information challenge does not become easier when energy and water is combined. However, assessment of the inter-linkages and trade-offs for water from energy development, and vice versa, is strengthened greatly by an environment of dialogue, trust and full sharing of data and information between decision-makers and affected stakeholders, both public and private. It must also be flexible and adjustable to rapid change. Energy and water data and information may be made more accessible through mobile technologies. The complexity of decisions on energy and water development often calls for combined energy-water modelling as a basis for developing integrated decision support systems. In both sectors advanced models have been developed, and efforts to further combine and apply integrated energy and water modelling systems are underway. Such developments include hydro- and energy economics, ecological and hydrological effects, social criteria and economic tools to quantify trade-offs.

Bridging the science-policy-people interface for energy and water

In the final declaration "The Future We Want" from world leaders at the Rio+20 Summit in 2012 the chapter on energy contained no reference to water, and the water chapter did not mention energy. Clearly, whilst a lot of information about the water-energy linkages has been developed, awareness and knowledge have not transcended sectoral boundaries at the administrative and political levels. The science-policy-people dialogue on energy and water needs to be improved based on increased "energy and water literacy" and a genuine effort to communicate advances in science and good practice, as well as innovation in technology and management, to our political decision-makers. Meanwhile, political decision-makers need to set the agenda and framework for the science and technology to become policy relevant.

In the developing countries in particular such efforts need to be associated with efforts to develop capacity at all levels to address these inter-linkages.

Simplified diagram of some major interlinkages between ecosystem services, energy and water



Note: Bold arrows indicate a major dependency; dashed arrows indicate major, usually negative, impacts; and shading indicates that water flows play a crucial role in these interactions. Categories of ecosystem services are according to MEA (2005).
Source: UNEP.

Water and Energy Sustainability

Development is a Janus. Reducing poverty, triggering economic growth and building up a more inclusive society are outstanding collective achievements that come with new and bigger social and environmental challenges and with the need to reconcile the different objectives in the continuous quest of a sustainable development path1. Success in economic growth requires harnessing the potential of ecosystems to satisfy the demands of water and energy which are essential for life as well as for the functioning of the many production and consumption processes where water and energy intervene as irreplaceable inputs.

> *Total energy consumption is already six times what it was in 1950 (WWDR), and is projected to grow by as much as 55% by 2030 as the combined effect of population growth and the improvement of living standards. It's hard to overestimate the combined effect of more people with better consumption boxes over water and energy resources: it takes 1.5 cubic meters of water and almost 10 megajoules of energy to produce 1 kg of wheat and around ten times more water and 20 times more energy to produce 1 kg of beef. The combined effect in a business as usual scenario might have outstanding effects over the environment and will put at risk maintaining the economic and social advances obtained: to feed the world in 2050 food production may need to grow by 70% which may require 50% more water but by 2025 two in every three countries will be water stressed and 2.4 billion people will face "absolute water scarcity".*

Managing the environmental impacts of water and energy

- The benefits of water and energy provision to poverty alleviation and economic progress are often accompanied by impairment of ecosystems with potentially harmful effects over nature and significant but unquantified costs. These benefits comes with increasing water scarcity, higher exposure to droughts and with extended impacts over the natural ecosystems that are increasingly transformed.

- Global warming, population growth, urbanization and growing consumption of water and energy continue to disrupt our already fragile ecosystem. These unsustainable trends are reinforced by market and political drivers that still tend to favor further developments of water intensive activities in arid and semiarid areas where there is not much water available. This is also a trend in emerging economies some of them in Asia and Africa are dangerously short of water. For example China has 20% of the world's population but only 7% of its fresh water and half the population and most of the agricultural and manufacturing growth tend to concentrate in the Northern half where

water resources per head are only 200 cubic meters per year per person only one fifth of what is conceived as a safe standard.

- But infrastructures are only one part of the assets required for the provision of the water and energy services we depend on. Human development depends also on the environment which is a complex collective asset that ultimately provides the water and energy services, on which life and the economy depends on. Moreover increasing and competing demands on water and energy as well as the changes required to cope with them may compromise the potential of nature to sustain economic progress and continue providing other valuable environmental services.

> *The 'Nexus Dialogue on Water Infrastructure Solutions' leaded by IUCN in partnership with the International Water Association (IWA) and the US State Department, is designed, to bring together key actors from each of the water, food and energy sectors to build partnerships needed to take practical, collaborative steps in creating and implementing water infrastructure solutions that will accelerate action on optimisation of the nexus.*

- Further, environmental degradation, competition for water and scaling energy prices may aggravate the already and inequitable access to water, both in urban and rural settings. These trends will always greater affect those without access to affordable alternatives or cost-effective means of coping, adding to the driving factor behind poverty. Failure to address these key issues will result in increasing ill health for children and the elderly and growing inequity and further marginalization of the poor and vulnerable, particularly women.

Some environmental effects of water and energy

- One of the most important and visible forms of the impact of pollution is the acidification of water – "acid rain"– resulting from the combustion of fossil fuels primarily used for generation of electricity, which is a major problem in many parts of the world. The resulting changes in the chemical composition of water affect agricultural productivity and disrupt ecosystems.

- Sedimentation of waterways through the loss of topsoil caused by fuel wood harvesting also affects many hilly regions and degrades ecosystems. The effects of climate change caused by burning fossil fuels disrupts existing water resources and supplies, displaces people and undermines their livelihoods. Pollution knows no borders either.

Managing the environmental impacts of water and energy

Recognizing that ecosystems provide a variety of services to the water–energy nexus can help the management of trade-offs and ensure that short-term gains do not undermine services that are critical for resilience and long-term environmental sustainability. Development impacts threaten clean water provision, food provision, climate stability and water regulation. Above all reaching sustainability means tackling the joint transformations that providing water and energy to fuel and feeding economic progress might have over the environment. But not recognizing the water

environment as an important asset for the provision of water and energy and for the control of its own quality, in particular when water is already scarce, may lead to the wrong combination of natural and man-made capital with important consequences for human development.

Implementing the water and energy nexus sustainably

- Never miss the opportunity a good crisis provides. Biodiversity losses, alteration of river systems and other forms of environmental degradation have rarely proven to be a decisive factor in taking immediate and drastic action. But development trends provide evidence for the importance of preserving the environment on the basis of water, energy, food access as well as providing an economically comparative advantage through making use of water sustainability in the long term. Sound economic, even financial and market driven thinking may be a powerful lever to push up water ecosystems conservation to the top of both water and energy policy agenda.
- Objectives of water and energy policies need to be reconciled. When put together water and energy challenges provide an outstanding opportunity to create a dialogue in favor of preserving the water environment based upon the economic importance of the services it provides. This dialogue is also essential to avoid the risk of sorting out one problem at the expense of the other or even worse pursuing unsustainable trends in water and energy at the expense of the environment and then of current and future generations.
- Water and energy strategies need to be simultaneously rewired for the long term. Though important in the short term current deficits and unsatisfied demands water and energy cannot shade or relegate long term priorities and in particular the objective to rely in a sustainable mix of both water and energy resources as a condition for building a sustainable future. The traditional options to put more and more water and energy into use are as exhaustible as the water and energy sources themselves. A transition need to be made from non-renewable to renewable options, from increasing supply to a wise management of the resources available and from infrastructure development to a more balanced mix of infrastructures and ecosystems for the production of the valuable water and energy services people, the economy and the environment depends on.
- Restoring the balance between natural and human made infrastructures needs to be recognized as an important element to reconstruct water and energy access. Restoring impaired ecosystems by recovering some of the basic functions performed in the past can be a valid cost effective alternative to reduce risks and exposure in many different ways. For instance, instead of using traditional infrastructures alone, flood risks can be controlled by recovering rivers' flood plains and by good livestock, forestry and agricultural practices on slopes that maximize their ability to retain water for infiltration and soil formation. The recovery of aquifers might substantially reduce drought exposure by building buffer stocks and green infrastructures, such sustainable urban drainage systems may serve to storm management while increasing runoff and control temperature. All these measures intended to recover natural assets and the functions they perform might result in the simultaneous saving of substantial amounts of energy, important reductions in water provision and treatment costs and significant benefits for ecosystems and the services they provide.

- Maintaining environmental flows is fundamental for decoupling economic growth from water uses and water pollution. Maintaining environmental flows provide important ecosystem services. Decoupling economic growth require proactive measures to ensure adequate allocation of water to the natural environment, in addition to the traditional economic sectors and drinking water.
- Building resilience and managing uncertainty: Climate change has the capacity to make a significant impact on the hydrological cycle, leading to a rise in extreme weather events such as floods and droughts. This fluctuation disturbs the energy management system and represent a genuine threat to energy and water access can emerge.

Water and Energy Sustainability: tools for improvement

- Promote private-public partnerships to foster the redevelopment of long-term business strategies and not just short-term strategies. This implies building networks to build water sustainability (preserving or recovering water sources, empowerment to local communities, promote innovation and technology development and diffusion, share risks, etc.). Public commitment to reduce water and energy scarcity might then create the conditions for sustainable long-term public and private investments and employment opportunities.
- Improved transparency of water and energy prices and investments. The clarity in communication would encourage more professional and public engagements and public trust. Such an engagement is vital for both the water and energy sectors, especially in relation to the subsidies that may exist and the pricing systems to make energy and water affordable to the poor in the short term without risking financial sustainability in the long term.
- Payment for ecosystem services (PES). When properly negotiated, designed and implemented these payments are instruments to enforce collective agreements and share the benefits from preserving water providing ecosystems. These agreements may serve to provide energy especially in rural areas, to promote sustainable land use practices, increase food access and create income opportunities for the poor while reducing erosion, retaining water, reducing energy needs.
- Output oriented fiscal incentives ranging from subsidies, tax deductions and price premiums that can play an important role in triggering innovation and speeding up the diffusion of innovations and newer technologies. Energy and water prices need to be revised to send signals of scarcity and promote the required change to sustainable portfolios of renewable energies and sustainable water sources.

Policy instruments

- The integration between water management and energy strategies insuring ecosystems protection. Developing a shared diagnostic of why institutions fail to avoid unsustainable trends. This requires raising awareness and building a shared vision of the challenges and the alternatives available to build up collective water and energy access in which conservation of water related ecosystems as well as the promotion of renewable energy sources may play a key role along with further advances in the Green Economy Agenda. Private firms concerns about water access, awareness of local communities in rural areas and

increasing evidence of vulnerabilities to extreme events are all ingredients to foster broader support for collective action and long term seeking water and energy policies.

- Building broad constituencies around long-term vision and objectives. For Governments, firms and stakeholders must be encouraged to take a longer-term view, to invest in water conservation, and investments in new energy sources assuming higher costs in the short term in exchange for long-term benefits. Public awareness creation, public participation and education is essential to foster collective actions as well as to make individual decisions on the use of water an energy compatible with sustainable supplies.
- Improve governance through transparency and accountability: Poor governance, corruption, short sighted decisions of local and foreign players may have a dominant influence in the policy decision making process and result in missing the opportunities to foster progress before critical resources like water, energy and land are depleted. A first step in improving governance consists in development outcome oriented and performance indicators promoted both by local and international institutions.
- Improvements of regulatory bodies. A strong regulatory body would be capable of tapping the leaks and discovering room for improvement in the water and energy management systems through benchmarking and setting standards. Improvements of participation of interested parties on water and energy in the development of policy and laws related to energy and water use so that they are more flexible and adaptable to be able to respond or/and mitigate extreme events and environmental impacts.

Assessment tools

- • Integrated economic and resource accounting systems of water and energy, similar to those used by few countries.

The International Resources Panel work on water and the report on "Measuring Water Use in a Green Economy" (IRP, 2012) are good examples on how water accounting can serve as a crucial tool for the purpose of overall water management. These accounting systems are based on the generation of physical assessments alongside with GDP growth and other economy-wide indicators and the related greenhouse gas emissions. Considering ecosystem services within such resource accounting schemes and establishing the links between resource efficiency, biodiversity and the connection to the socio-economic values of water is still work in progress. • A systematic life cycle thinking perspective, considering both direct and indirect water and energy use for products and all relevant environmental impacts at production sites along the supply chain all the way to the end user.

- Development of tools and indicators to quantify decoupling. Particularly in terms of accurate measures of water and energy use and its impacts on ecosystems. This knowledge is essential to support efforts to set targets, design policy instruments and monitor progress.
- More systematic use of tools such as environment assessments, and economic valuation. A systematic use would help in mapping the water and energy interdependencies better which would help in exploring different dimensions to the problem.
- Science and industry partnerships on water and energy sustainability are more important than ever because it helps developing a strategic approach towards innovative alternative solutions derived from a better understanding of the risks and the advantages of sustainable approaches.

Technological innovations

- Green infrastructures;
- Recycling and reuse of water –including when water of different qualities is used in different subsequent uses (reducing stress on energy for extraction of water from the underground water table);
- Information and communication technologies (for tapping the energy and water leaks);
- Rainwater catchments (leading to underground water replenishment with rainwater harvesting and thus reducing the stress on energy for extracting underground water);
- Better land-management practices and technologies that improve water productivity in rain-fed and irrigated areas (thus lesser use of energy for pumping water from aquifers);
- Use of renewable energies or other innovative technologies for groundwater pumping, desalination, water purification and wastewater treatment;
- Savings in urban water use -eco-design, urban planning (leading to reduced stress on energy for extracting underground water).

Risk Management

There is now increased pressure for companies to operate in a way that reduces adverse impacts on the environment and local communities. This concern is not just about brand reputation but also about financial prudence. Energy access and water-related risks have increasingly been seen as significant in evaluating long-term business viability.

3. Experiences and proposals from projects and cooperations

How water pricing and valuation can be incorporated in energy planning, and its implication on the energy mix?

Does exist some business case for valuation to highlight the need for economic analysis to inform decision makers on the benefits of integrated energy and water planning?

How financial analysis can be used to determine potential impact on revenues of water scarcity?

Energy utilities often face shut-downs for days at a time due to scarcity of water, low flows and/or increasing water temperatures. Hence, there is a strong business case to integrate the planning of energy and water, by designing and implementing joint investments. The current challenges require that the energy sector addresses the complex hydrological aspects. There is also a solid economic case as integrating energy and water generates an array of benefits to society by increasing welfare, reducing poverty and sharing prosperity. Integrated investment planning poses challenges but generates demonstrated financial and economic returns. The business community is paying increasing attention to valuation of energy and water resources which goes beyond pricing as it promotes good stewardship and leads to improved efficiency.

Internalising valuation can improve the business operations, limit wasteful practices and inform management decisions.

It's urgent to have fair remuneration of hydropower regarding its impact on river ecosystem by energy prices.

MCA a support for decision making applied to the nexus energy-water / SESAMO opens new opportunities:

Multi-Criteria Analysis (MCA) is a decision-making tool developed for complex problems. In a situation where multiple criteria are involved confusion can arise if a logical, well-structured decision-making process is not followed. Another difficulty in decision making is that reaching a general consensus in a multidisciplinary team can be very difficult to achieve. By using MCA the members don't have to agree on the relative importance of the Criteria or the rankings of the alternatives. Each member enters his or her own judgements, and makes a distinct, identifiable contribution to a jointly reached conclusion.

The balance model that MCA with SESAMO proposed opens a large opportunity to consider both the sensitive place of biodiversity but also the importance of the economic value of products. It gives the possibility to really imagine a sustainable model of development for mountain regions linking with a higher transparency ecosystem services and production of hydropower. AIM proposals could also be an efficient way to organize with the support of the MCA a system of compensation mobilized by the eco certification of electricity (green certificates or labels). The market of hydroelectricity would give a price for a production that could be identified throw the MCA to a certain level of quality of river ecosystem. Then we would have equivalence between an ecological service and economic value.

Rewarding benefits through payments and markets: Payments for ecosystem services (PES schemes) can be local (e.g. water provisioning) up to global (e.g. REDD-Plus proposals for Reduced Emissions from Deforestation and Degradation, as well as afforestation, reforestation, and effective conservation – if designed and implemented properly). Product certification, green public procurement, standards, labelling and voluntary actions provide additional options for greening the supply chain and reducing impacts on natural capital.

Reforming environmentally harmful subsidies:

Global subsidies amount to almost 1 trillion € per year for agriculture, fisheries, energy, transport and other sectors combined. Up to a third of these are subsidies supporting the production and consumption of fossil fuels. Reforming subsidies that are inefficient, outdated or harmful makes double sense during a time of economic and ecological crisis.

Addressing losses through regulation and pricing: Many threats to biodiversity and ecosystem services can be tackled through robust regulatory frameworks that establish environmental standards and liability regimes. These are already tried and tested and can perform even better when linked to pricing and compensation mechanisms based on the 'polluter pays' and 'full cost recovery' principles – to alter the status quo which often leaves society to pay the price.

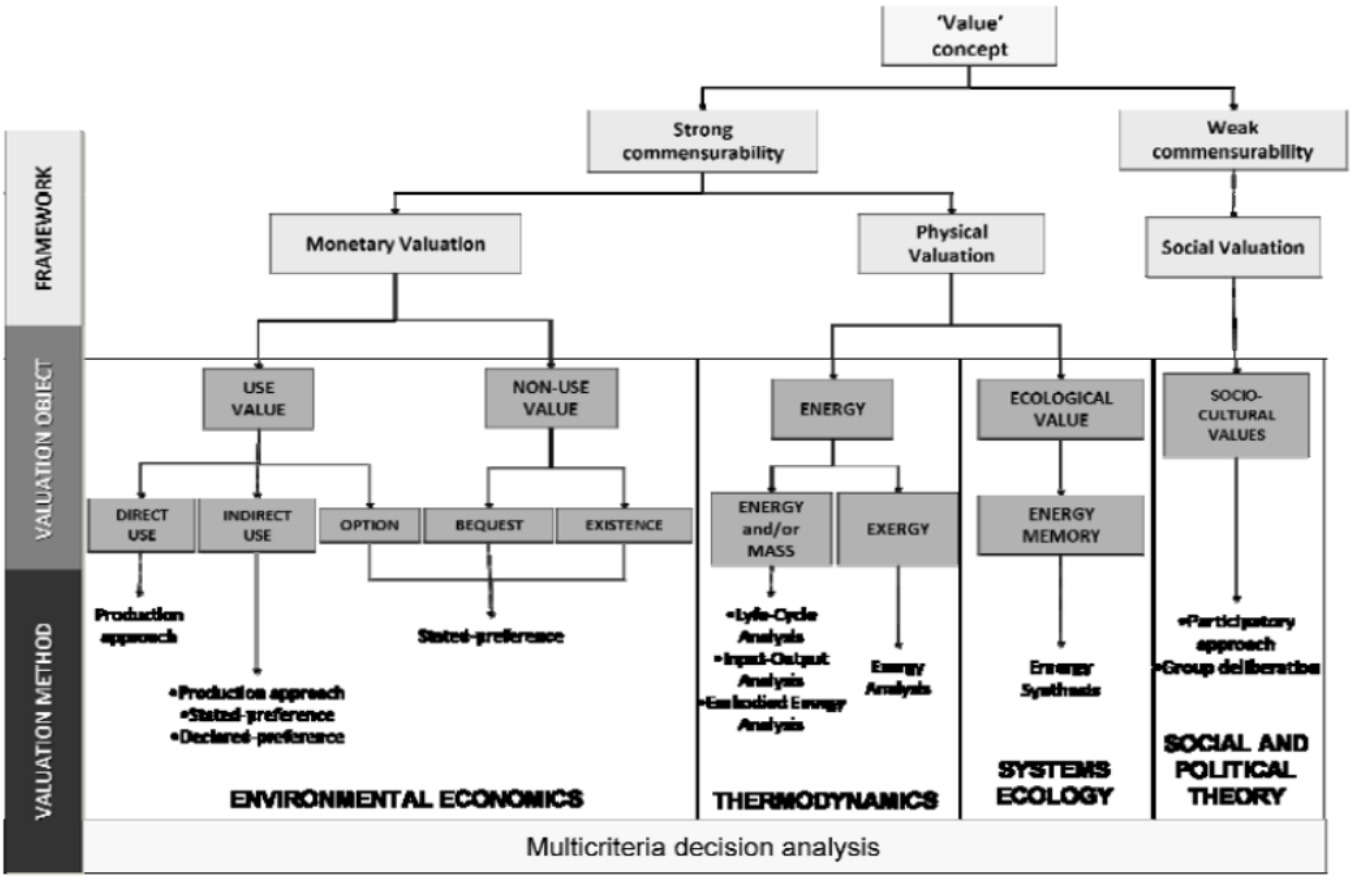
By-the-way, the real cost of hydropower should also take into account the price of ecosystem and the various elements in discussion about concession and public procurement of hydropower installation should take that into account.

SESAMO gives the opportunity to share a sustainable model of development and to organize new regional environmental governance which both can face the objectives of EU 2020 regarding green growth.

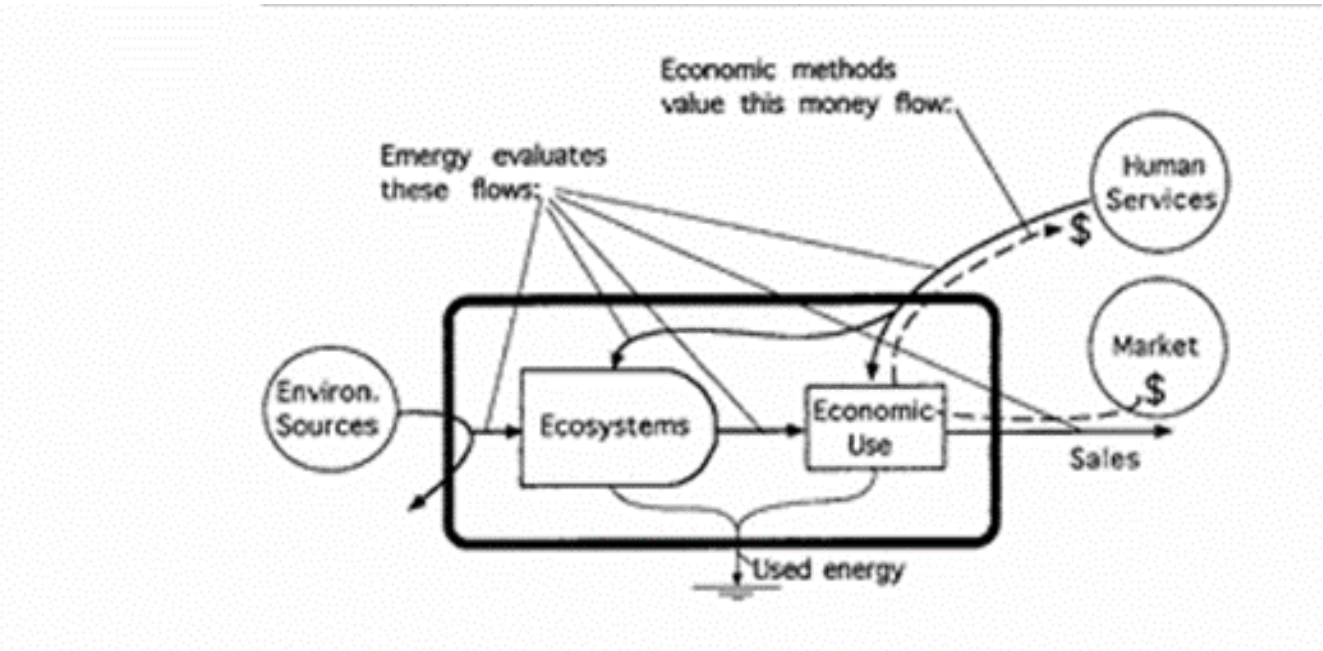
To keep into deeper scientific analysis, energy could be used as one commune denominator.

It has been demonstrated by the article "The Energetic Basis for Valuation of Ecosystem Services" written by Howard T. Odum and Eugene P. Odum.

Within the strong commensurability context we can distinguish two approaches for valuing ecosystem services: monetary valuation and physical valuation. The utilitarian approach to the monetary dimension of value is enclosed within the Environmental Economics, whereas the Ecological Economics place importance on alternative values such as those based on matter and energy flow analysis (Pritchard et al., 2000).



Conceptual framework reflecting the different languages of valuation and the most frequently.



Interface between ecosystems and economics comparing evolutions. Current economic procedures place monetary values only on the market-to-human services flow, whereas the author evaluates all of the flows shown.

Then, it appears that energy also helps to valorize the transformation of natural resources into human services. As energy has a market price made by the confrontation of human demands for economic and social needs, technical organization and material investments, and environmental costs of natural resources.

In a way, this analysis helps us to understand how energy production gives a value to the use of ecosystems, but also to their creation and conservation.

Nature conservation is not a free action; it is a political choice and an investment for future as for well-being. A sustainable economic model, considering cyclic trends, should therefore integer the real price of energy production by considering the real price of water ecosystem and a compensation system made of local investments measures to maintain a sustainable development.

Hydropower generation is needed to face climate change adaptation; how the necessary investments could maintain a high level in water quality and also support local development of mountain water production ?

Conclusion: A leading challenge for the Alpine region

The link between renewable energy and ecosystem services made with AIM is stimulating to organize better the new model of green economy that the Alps could propose to Europe. Therefore, Water and Energy should be topics to be develop in a European macroregional strategy for the Alps.

The integrated analysis that the AIM proposed as the one develop by other projects in the Alpine space territorial cooperation program is a clear argument to develop in the EUSALP action plan some strategic objectives in favour of river conservation and sustainable hydropower production.

The ecosystem approach needs spatial development to coordinate the different land uses and development of activities at a coherent scale. Therefore, the Alpine region is clearly one of the most interesting example in term of regional environmental governance. To reach its potential assets, the Alps need a sustainable special strategy that would be enriched by the ecosystem approach.

Resolving the paradoxical opposition between adaptation to climate change and conservation of ecosystem, AIM as a capitalisation project opens a large and efficient toolbox for decision makers and policy makers in charge of developing hydropower and assuring a high water quality. This key challenge for the Alps should have a strategic role in EUSALP action plan.