Energy in Mountain Areas

Strategy Proposal

Position paper of Euromontana

Euromontana is the European multisectoral association for co-operation and development of mountain territories. Euromontana brings together organisations of mountain people: development and environmental agencies, agricultural and rural development centres, territorial authorities, research institutes, etc. It includes organisations from Western Europe as well as from Central and Eastern European countries with the aim of developing international co-operation. Currently 72 organisations from 17 wider European countries are members of Euromontana.

Euromontana's mission is to promote living mountains, integrated and sustainable development and quality of life in mountain areas.

In order to achieve this, Euromontana facilitates the exchange of information and experience among these areas by organizing seminars and major conferences, by conducting and collaborating in studies, by developing, managing and participating in European projects and by working with the European institutions on mountain related affairs.

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Euromontana thanks its members

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1. Background

1.1. The European Union Energy Policy: the role of mountainous areas

1.1.1. In March 2006, The European Commission published a Green Paper on Energy (COM (2006) 105), in which it laid out in detail the current situation and future perspectives regarding the consumption and the supply of energy, together with strategies for increasing competition and opening up the energy market, as well as ways for reducing pollution, ensuring the security of energy supplies and of the internal market's energy networks, with a view to the EU possibly achieving energy independence in the future.

1.1.2. However, the document, which analyzes the current situation of the energy market with a high degree of realism, gives natural renewable resources scant consideration when compared with fossil energies. Moreover, the specific nature and the resources of its [Europe's] territories – such as its mountainous regions – are not taken into account, even though they have a special importance in Europe.

1.1.3. By virtue of its proximity to nature as well as the culture of its inhabitants, mountainous regions are an ideal area for reducing energy consumption while maintaining a high standard of living, and lend themselves to large-scale experimenting in the use of renewable energy sources. Energy independence for areas representing 40.6% of the EU's territory and 19.1% of its inhabitants[1] (approximately 90 mn out of a total population of 450 mn), can provide a vital stimulus to the EU to reach the goals it has set for the year 2020 (the « 20-20-20 » objectives), and show that the goal of energy independence is attainable and not just a dream.

1.1.4. **This paper therefore seeks to highlight four key aims of mountain regions for the future:**

a) **Becoming as energy efficient as possible;**
b) **Helping mountain communities become energy secure through local production from diverse resources;**
c) **Creating the capacity and the appropriate networks for mountain communities to become exporters of their energy products.**
d) **Through research and practical pilots generating an expertise that can be transferred around and shared with Europe.**

1.1.5. This paper does however recognise that this is but the first step in a new process of developing energy strategies for the future of Europe. Therefore, and realistically at this stage, this paper can only highlight the basic principles and opportunities the mountains can offer in helping the European Commission develop a new European Energy Strategy. With this in mind Euromontana would welcome further opportunities to deliver more detailed papers on the

[1] Mountain Areas in Europe, Analysis of mountain areas in EU Member States, acceding and other European countries, commissioned by DG Regio to Nordregio, 2004.

different resources, generating models, transmission networks and storage at a later and more appropriate date.

1.2. The electricity market and basic supply

1.2.1. The recent blackouts that occurred in the European Union and the United States point to the need to establish clear rules for managing the supply network and therefore to ensure the proper maintenance and development of the network itself. The White Paper on Services of General Interest (COM(2004) 374) recognizes the principle according to which all citizens and businesses in the European Union should be able to enjoy services of general interest at an acceptable cost. This principle also applies to the electricity sector. Since July 1, 2007, the EU's electricity market has been completely liberalised. This opening of the market has raised the question of whether the market is able to guarantee a basic supply to all citizens and businesses in all the regions. The answer, it seems, is that this basic supply is the responsibility of the national legislatures, which may delegate it to lower levels of authority.

1.2.2. The Member States must establish a transparent general policy with regard to supply, one that is non-discriminatory and that is compatible with a competitive single market for electricity. They must define and make publicly known the role and responsibilities of the competent authorities and those of the various market participants. (Legal basis: Directive 2005/89/EC of the European Parliament and of the Council of 18 January 2006 concerning measures to safeguard security of electricity supply and infrastructure investment.)

1.2.3. When the Member States adopt the executive measures for these policies, they must take certain factors into consideration, particularly the need to:

- ensure the continuity of electricity supplies;
- examine the internal market and the possibilities for cross-border cooperation in relation to security of electricity supply and transmission;
- reduce the effects of the long-term growth in electricity demand ;
- diversify electricity production in order to ensure a reasonable balance between different energy sources;
- promote energy efficiency via specific measures in E.U policies and programmes and the adoption of new technologies;
- continually renew the transmission and distribution networks in order to maintain efficient transmission and equality of access to energy across the Union .

1.2.4. Those in charge of the transmission networks must establish minimum operational rules and obligations to ensure the operation of the distribution network. These rules and obligations must be approved by the competent authorities if the Member States so decide, and must also be adhered to by the transmission network operators.

1.2.5. For Euromontana, **a stable supply at an affordable price is essential to ensure the attractiveness of the mountain regions, as places to live and work.** Euromontana **therefore**

calls on the competent territorial authorities to make sure that the principles of basic supply are applied in their own legislation. The regulatory authorities play an important role in this regard by guaranteeing that these principles are applied. They need to have an explicit mandate to oversee basic supply. Furthermore, the regulatory authorities need to be able to work independently from the power generation and transmission companies.

1.3. The Climate change and mountainous regions

1.3.1. The reference scenario serving as a basis for a European energy policy specific to mountainous regions is primarily that of climate change. The environment in mountainous regions is one in which changes in the landscape, climate, flora and fauna are particularly evident, and have immediate and medium-term consequences for the economy in these areas which are already under considerable threat. There are also long-term consequences, still being studied, those affect environmental security and reduce the availability of natural resources that can produce energy, thereby undermining the viability of these areas. This has the potential to increase the depopulation and impoverishment of mountainous areas.

1.3.2. The Alps offer a perfect example of the risks involved. According to the EU's White Paper on Adapting to Climate Change (Com(2009) 149), the Alps are among the areas most vulnerable to climate change in Europe. Between the end of the nineteenth century and the beginning of the 21st century, the temperature there has increased two degrees, or nearly double the average increase for the northern hemisphere. The most visible effects have been glacial melt, a decrease in snow cover, changes in the average flow of rivers and a decrease in water resources in general. In Switzerland, in the heart of the Alps, the change has been significant: it is estimated that the production of hydroelectric energy will have decreased by 7% in 2035, by 11% in 2050, and by 22% in 2100, in comparison with the production in 1961-1990. The impact of climate change will be even more strongly felt in certain areas: the hydroelectric plant in Mauvoisin, Switzerland, will, according to reliable forecasts, see its production drop by 36% between 2070 and 2099. While glaciers in the Alps have shrunk by 40% over the last 150 years, those in the Pyrenees have shrunk by 80%. Snow cover on the ground in the Pyrenees now last less than approximately ten days in the winter, and the forest cover in the French mountains gained three meters in altitude each year between 1971 and 1993.

1.3.3. To fight effectively against greenhouse gas emissions, which are usually considered to be largely responsible for the increase in average temperature, and in order to limit the increase in temperature to less than 2 degrees, it is necessary to follow international recommendations that stipulate a 75% reduction in greenhouse gas emissions. The objective that has been set for industrialised nations is to realise a 50% reduction by 2050. In Europe, the objective that has been suggested by the European Commission is a 20% reduction by the year 2020, within the « 20-20-20 » framework, i.e.:

a) 20% reduction in greenhouse gas emissions;
b) 20% reduction in total energy consumption;
c) 20% of energy produced using renewable resources.

1.3.4. In line with the European Commission's Green Paper *Adapting to climate change in Europe – options for EU action* of 29 June 2007 (COM(2007) 354), new strategies need to be found that will serve as a basis for a **new transversal legislation**. Europe's mountainous regions are the ideal laboratory for cutting-edge research into climate change, and the agencies and organisations that deal with environmental development and the economy of mountainous regions – some of which are also members of Euromontana – could serve as **a core body for continuous research,** in which survey methods and observational data could be brought together, speeding up the diagnosis of problems and hastening the development of strategies to fight against or adapt to climate change. One example is the Ev-K2-CNR permanent observatory, a volunteer association supported by the IPCC (Intergovernmental Panel on Climate Change), and thus by the United Nations, that was established to create, together with 180 international scientific institutions, a network of data sites on European mountains, in line with similar observatories already set up on K2 and Karakorum, i.e., the « Roof of the World. »

1.3.5. **Euromontana supports the need to develop sustained, concrete action, within the operational framework provided by this document, which can become a model « territorial climate plan » for mountain regions, where there unique characteristics are taken into account and utilised.**

1.4. Extracting from the Brig Declaration principles an Energy Strategy for Europe's Mountainous Regions

1.4.1. To establish a new policy of territorial cohesion specific to the mountainous regions of Europe :

- by focusing on the problem of climate change;
- by fighting against depopulation – especially by bridging the « digital divide » and by investing in new communication technologies;
- by supporting the traditional economic activities of the mountain regions, such as agriculture and the production of typical products (which means asserting its identity).

1.4.2. Indeed, according to Euromontana's[2] Brig Declaration, the following must be recognized:

a) The potential geopolitical influence of the mountain regions in stabilising and unifying Europe in the face of economic and political movements;
b) The unique role that Europe's mountainous regions can play in ensuring the Europe's territorial cohesion;
c) The economic and social value of managing the land and habitat in the mountains for the European community as a whole;

[2] Euromontana Declaration of 10 October 2008, 6th Annual European Conference of Mountainous Regions, Brig, Switzerland.

d) The high-quality yet extremely fragile assets that mountainous regions represent, with their high level of biodiversity, and the authentic variety of their local food and artisanal products and their culture.

1.4.3. This uniqueness of mountainous regions, serving as a natural real-life laboratory, may help in dealing with the following at the European level:

a) The challenge of climate change, which has a stronger effect on mountainous areas than it does elsewhere;
b) The challenge of depopulation and the aging of the population;
c) The pressure exerted through European policies toward territorial cohesions: this translates into economic polarisation of capital, and excessive urbanisation and too great an attractiveness of urban areas in general, which lead to pollution, congestion, a lowering of quality of life in areas that are distant from cities due to a dramatic decrease in accessibility to services and economic activity;
d) The imperative to find a new balance for the Common Agricultural Policy after 2013, in order to preserve rural areas and maintain territorial cohesion, by developing a high-quality agriculture capable of being an important part of the economy in mountain regions.

2. Energy savings

2.1. Reducing consumption while increasing quality of life

2.1.1. Energy savings must be the starting point in considering any revision to E.U. energy policy. Reducing energy consumption helps reduce the demand for production and thus lowers the production of CO2, and therefore pollution. **Mountainous regions can make a key contribution toward realising the EU's 20-20-20 objectives,** though their natural resources:

a) Energy-efficient building materials;
b) Use of renewable energy sources for heating to replace fossil fuel systems
c) Using renewable energy resources to support the business sector

2.1.2. Mountain communities have always had an interest in energy efficiency. High altitude communities have a long tradition of building and living in an environment where maximising the heat and energy resources was vital for survival. This tradition has lead to a cultural 'expertise' and interest that exists today. The need to build dwellings and other buildings that are energy efficient continues in light of the impacts of climate change on our way of life. Mountain peoples can offer their knowledge and expertise in traditionally energy efficient structures as a starting point for new research and the development of technologies and products for the 21st century and beyond.

2.1.3. The autonomous province of Trento – an Italian province entirely situated in a mountainous region – offers a striking example. Between 2000 and 2008, multi-sector policies on energy savings were instituted, focusing on residential buildings and on the establishment of an « Energy District », between Trento and Rovereto, in which businesses and research institutes were brought together to foster the development of a new kind of construction. The objective was to develop new technologies using traditional materials there were available locally (wood), new ways of doing business, new professions and new trades. The project was undertaken in collaboration with the local university, with a view to making progress toward future building techniques with "zero impact ".

New buildings that met the standards laid out in Directive EU 2002/91/EC were erected with energy consumption at least equivalent to « Class B », that is, an energy consumption less than 60 Kwh/m², which translates into an energy savings of 80% in comparison with current standard practices. Applying the class B standard to all new construction, as prescribed in a recent debate of the Trento Provincial Council (June 2009), should make possible energy savings of 32% in the next 5 to 10 years in the province. In addition, transition to a certification system with an even broader scope - the U.S. Green Building Council's LEED (*Leadership in Energy and Environmental Design)*, which would result in an evaluation of all new construction in all its environmental and energy aspects - is being evaluated. This kind of evaluation and certification system could also serve as a reference for quality certification that mountain regions would like to implement (see part 4).

2.1.4. The heating of domestic and business premises represents one of the biggest areas of energy efficiency opportunities in mountain communities. The use of traditional insulating materials, design and modern technologies in heating systems offers the opportunity for mountain communities to lead the way in developing new models for heating buildings and reducing the carbon footprint dramatically. Technologies such as solar thermal, solar PV, ground and air source heat pumps are already being regularly used in remote upland communities to reduce the carbon footprint of buildings and reduce the cost of fossil few heating systems. The significant use of these technologies in mountain communities highlights their value, both to the users and as laboratory examples to help develop the best models in a range of common to extreme circumstance.

2.2. Renewables and business: using better energy models

2.2.1. The preferred mode of energy export for mountain areas at present is through the electricity grid. It is recognised, however, that there are no guarantees that the necessary grid upgrades will be made quickly. In addition, energy conversion to new fuels such as hydrogen and methanol may provide medium and longer term opportunities for exporting energy from energy-rich mountain areas.

2.2.2. Attracting energy intensive industries to areas of abundant and cheap energy production such as Europe's mountainous regions provides another alternative market for local energy.

Although grid supplied electricity is unlikely to be competitive, an off grid supply from a renewable source could be of interest, particularly if suitable back-up/storage can be found to meet demand requirements or, conversely, if demand levels can be varied according to supply conditions.

Developing internal grid networks to maintain consistent supply in mountain areas will reduce the impact on the landscape and combat the loss of energy through long distant transmission. Re-sighting industries to mountain communities in the centre of local energy networks would provide long term economic benefits for mountain regions and provide more sustainable futures for commercial enterprises in the future.

2.2.3. In mountainous regions, the primary objective must therefore be reducing energy, electricity, and heat consumption and using energy resources more efficiently. To achieve this it is important to consider a number of different strands of activity as follows:

- **Developing a new concept in building in mountainous areas** (design construction and homes in an energy-efficient manner, using traditional materials and advanced building technology, incorporating constant monitoring of the energy consumption and energy – smart buildings and home automation) ;
- **Undertaking an energy and landscape analysis of older inhabited buildings, which are often naturally energy efficient;** the historic centres of mountainous regions can serve as a model for the construction of new developments**;**
- **Introducing incentives to rethink the production processes of businesses in mountainous regions, especially SMEs (small and medium-sized enterprises), in terms of improving energy efficiency and attracting enterprises to mountain areas for energy security;**
- **Research in to the potential of local materials to support low energy construction.**

3. Area analysis as the basis for policy: the Energy Cadastre

3.1. Mountainous regions want to set an example for the rest of Europe.

3.1.1. Area study and analysis of its energy needs, the resources available, and the optimisation of consumption. This can be accomplished at the municipal level that of the provinces or departments, of a valley or an area with uniform characteristics, or at the regional level (Region, Land). The area analysis must lead to an evaluation of the energy needs of the population, based on the principles already mentioned of smart consumption and energy saving, and also lead to an evaluation of the area's potential to produce energy resources (for

instance, water, biomass, wind, solar power, geothermal energy).

3.1.2. In judging each aspect of a territory according to consumption and possible energy production, it is possible to establish an « **Energy Cadastre »** which will allow the punctual evaluation of the energy footprint of any activity (for ex., the building of a house, or the conduct of a given economic activity). As a result, these activities will receive support from the public administrations in due measure, though a policy of incentives or disincentives when granting building permits. Measures of this kind have already been implemented experimentally in many alpine regions. The Autonomous Province of Bolzano, in Italy, for instance, applies the KlimaHaus principles to evaluate requests for urban transformation, and encourages construction only when it does not deepen the ecological and energy footprint of human presence in the area.

3.1.3. This policy of caring for the area, the natural landscape and traditional construction, which has asserted itself in the history of Europe's mountainous regions, can serve as the cornerstone for a modern energy policy that Euromontana wants to see spread not only through the mountainous regions, but throughout the whole of Europe. The basic idea is to work on a concept of self-sufficiency for mountain communities, from small villages to small or medium-sized cities–while taking into account the actual conditions in the European regions. We propose to enact on a large scale the idea of an « energy land survey for European municipalities », in a uniform manner, in order to allow regions to take steps toward energy self-sufficiency and reduce the use of energy transport networks, which lower the overall efficiency of energy supply systems.

3.1.4. In introducing the "Energy Cadastre" concept as the first step to recognising the energy footprint of activities in mountain communities opens the opportunity for communities and regions to develop energy production models appropriate to their own areas. These energy production models should take into account the variety and volume of the resource prevalent in a region, the impacts on the landscape of a preferred energy production mix, the opportunity for developing energy export activities and the need to balance energy security and energy as an economic tool. Each mountainous region of Europe will need to identify the most appropriate energy production models and which resources best suit the needs and desires of their communities.

4. Energy Sources and Distribution

4.1. Introduction

4.1.1. Renewable energy sources must be at the foundation of an energy policy that acknowledges the specific characteristics of the environment in the mountainous regions. Their use should be developed to maximum extent possible before turning to the import of energy derived from non-renewable sources, fossil fuels (oil and natural gas).

4.1.2. Furthermore, energy sources naturally available in mountainous areas can have « knock-on » effects that are far from negligible at the territorial level:

- They can serve as a source of additional revenue for the producers or managers of resources (for ex., by selling the surplus locally produced energy on the energy market);
- water management undertaken for the production of energy can be used to control rising water, and can also meet water needs downstream;
- Using biomass fuel can help develop local resources, which can have a positive impact on land management;
- Producing biogas from animal manure can lead to a reduction in agricultural pollution;
- Other energy sources should be studied from this point, exploring other side effects of their exploitation.

4.2. Water: The Hydroelectric production

4.2.1. For more than 100 years has been used to generate hydroelectric power. In many European countries, up until the 1950s, it was the most important source of energy. At present, hydroelectric energy production has reached the maximum of its possibilities nearly everywhere in Europe, leaving little room for further large installations, but still leaving plenty of room for smaller, local installations. Technological innovation has made it possible to complement energy production, but is not destined to play as much of an important role in energy availability at the local and European levels In the future

4.2.2. The water resources of Europe's mountain areas[3] are a key asset with regard to Europe's energy supply. With a production of 76 GW, the three European countries with the largest production capacity (Norway, France, and Italy) are among the world's top ten producers[4]. These three European countries produced about 10% of the total world hydroelectric output. If we take Europe as a whole, with its mountains and water resources, it would rank as the

[3] The Alps are accordingly called « Europe's water tower » : they supply water to four great river systems : Rhine, thee Po, the Rhône and the Danube

world's second largest producer, behind China and before the United States.

4.2.3. However, climate change raises questions about how long this resource will be as viable, and should encourage all countries to make a greater effort in the area of scientific and technological research. A more rational use of water resources also needs to be found, because water has very diverse uses, from consumption by people to the cooling of geothermal and nuclear power plants, as well as irrigation, navigation, and to maintain the natural balance of the soil.

4.2.4. Water is one of the most important natural resources that mountain regions possess. In general, this resource is managed by the state or by public bodies, in ways that vary from country to country, in accordance with the legislation in effect. In Italy, for instance, water belongs to the central government. In Switzerland, on the other hand, water belongs to the cantons. Some Swiss cantons delegate ownership to the municipalities. However, despite the many uses of water, **the mountain regions are not always fully compensated** for the use of this resource; in the cases where there is a compensation for the use of water, a **problem of sharing the compensation in the territory may arise**. For example, only the municipality where a powerplant dam is settled will receive fees whereas the neighbouring municipalities will not, although it is although through their territory and water management that the power plant can work.

4.2.5. **Euromontana asks that territorial bodies, either local or regional, receive compensation for the use of their water used to generate hydroelectric power that is being used by other regions. The determination of price must be negotiated though a political process. This demand is in compliance with some national legislation, and with article 7 of the Energy Protocol of the Alps Convention.**

4.3. Biomass

4.3.1. Renewable bio-energy describes any energy process which utilises fuels derived from recently living plant or animal matter in a sustainable manner. Generally this falls into four main categories:

- Direct combustion of wood and other organic materials (e.g. household rubbish);
- Secondary production from wood and other organic material. By gasification or pyrolysis
- Secondary production of energy from wastes, such as animal slurry or organic refuse, through digestion or natural decay processes;
- Production of bio-fuels from oil-rich crops.

4.3.2. The production of oil rich crops in any significant way in mountain areas would suggest that this specific bio-energy option is less suited to development in mountain areas in the main because of the limitations of land available for growing such crops and the competition this

would create with the food sector.

Using traditional municipal solid waste to produce energy (electricity, heat), although it may be possible in mountainous areas, does not seem to be the best candidate for developing biomass as an energy source in mountain regions and would require in any event solving the problems linked to the nature and amount of emissions resulting from the burning of waste.

4.3.3. Another source of energy is the use of farm waste (biogas). Given the present state of research, this solution does not seem well-suited to the mountain environment. Several studies and surveys have reached the conclusion that the scale of farms, access to stach and the investment and maintenance cost combine to make this less attractive in mountain areas.

4.3.4. The use of biomass for energy production does seem promising, however, for wood by-products and cultivated short rotation wood crops. In this model electric or heat energy is produced while eliminating waste produced by agricultural and lumber activity or as a result of cultivating timber solely for the purpose of producing biomass for electricity generation, which moreover can play a role in reducing pollution and the amount of carbon dioxide in the atmosphere. This kind of energy generation deserves more attention if it is to be developed further. It needs to be mentioned that burning biomass is neither efficient nor clean unless appropriate modern technologies are used. In addition, the industry is currently experiencing supply problems. It is therefore advisable that local associations and public bodies encourage or assist in the development of this industry.

4.3.5. Wood resources can be divided into three different sources, which feed into technically different facilities:

- wood logs
- wood chips or woody mass
- wood pellets

4.3.6. Traditional wood logs are mainly for private use by families whose homes have either a fireplace or a wood burning stove. Its weakness lies in the fact that, unlike heaters that burn fossil fuels, there are no rules that monitor energy efficiency, despite the existence of regulations regarding the emission produced by the burning of wood. It has however to be noted that some stove are currently much more efficient than fire places and relatively interesting output (up to 80-85%). **The generalization of this kind of equipment, if not of the sufficiently advanced technology (minimum output of 90-92%, emission control though the use of particle filters on chimneys), may lead to a significant increase in the amount of particulate matter, especially in closed valleys, increasing PM10 air pollution**[5].

4.3.7. Opting for larger facilities which use wood chips or wood pellets to produce both electricity and heat could make it possible to serve more areas or clusters of villages, as well as a better

[5] *Particles with a median diameter of less than 10 µm. The amount present in the atmosphere is use an indicator of the level of pollution.*

control over facilities (which would lower the risk of air pollution). In order to foster the development of energy derived from biomass, it is necessary to find **the raw materials. They should come, in principle, from areas near the biomass plants**.

4.3.8. Within the Highlands of Scotland, for instance, there is a growing recognition of the value of Biomass energy systems. Commercial woodlands are widespread with biomass output presently estimated at approximately 200.000 oven dried tonnes' production per year33 over a plantation area covering 13% of Highland. Further forestry could be developed and existing areas of forest are normally replanted after harvesting. Some of these areas could be partially replanted with short rotation coppice tress thus providing diversification for local land managers. This is a significant market opportunity for the large areas of low grade commercial plantation in the North Highlands, subject to proper organisation of the wood supply chain and competitive pricing.

4.3.9. Building facilities of the right size is vital when **developing a sustainable wood-energy industry**. Building oversized facilities, in addition to inflating construction and maintenance costs, also leads to importing biomass from distant areas, using fossil fuels to transport them, cancelling out the positive aspects of using biomass as a renewable energy.

4.3.10. **Euromontana therefore suggests supporting and developing the wood-energy sector by:**

- the strengthening of associations that bring together the owners of public and private forest land (associations of property owners, forestry associations, municipal associations) ;
- intervention and investment in timber mechanisation in the areas of cutting, converting, unloading, and grinding of wood material not used in high-quality work;
- investment in technological innovation for businesses involved in the processing of wood and wood material;
- the strengthening of financing for projects to improve wooded areas as prescribed by the specific measures contained in the rural development plans (Reg EU 1698/2005 and 74/2009) for public ownership entities (for instance, municipalities) and private owners. Thus taking advantage of increased growth rates of timber associated with climate change
- maintaining « Green Certificates » prescribed by the legislation of Member States.

4.4. Solar

4.4.1. Solar energy, for both heating and producing electricity, is already extensively used in mountainous areas, with ever increasingly cutting-edge technologies. These technologies have already become standard in the area of heating, while there has been rapid change in the area of photovoltaic panels that produce electricity (120 -170 W/h/m² for the latest models).

4.4.2. In the mountains, certain aspects of the environment make photovoltaic systems especially effective: air quality, sunlight, lack of fog or dust, air temperature. The problems that mountain communities face is rather the breadth of territory needed to set up a large number of photovoltaic panels, something that is indispensable if the underlying concept is that of a « power plant ». To maximise the opportunities for larger scale solar energy production storage technologies, transmission networks and local networks need to be considered, researched and improved. However this is the case with all the mountain energy resources. At present much of the installed solar capacity is in the domestic small or individual building scale. Yet, like other energy resources, to maximise them we are not solely reliant on technological advances in the energy production. This problem underwrites a significant weakness in Europe's energy networks which urgently needs addressing to support renewable energy production.

4.4.3. The example provided by Aveyron, a department in France is revealing. The land of this mountain province is kept up and developed by around 9,000 cattle breeders, who have buildings that provide shelter for the animals and a place to store winter fodder. The slope of their roofs and a southern exposure are key if photovoltaic panels are to be used. The breeders created a consortium to produce energy for their own use and to sell on the market, thus earning additional revenue. So far, 500 breeders have chosen to invest in this idea, the average faculty covering an area of 420 m², which in all is the equivalent 21 hectares of open land, and 30 megawatts of power.
If 20% of buildings were covered with solar panels, the total amount of power produced would equal 10% of that of the average nuclear power plant (0,1 GW). In this instance, however, the energy would be produced using a natural and renewable resource. One hundred other projects are also under consideration in the department of Aveyron, averaging 2,200 m² in area and with a total projected power output of 33 GW.).

4.4.4. However, it is clear that there are massive potential visual impacts on the landscape and other effects on the environment of large scale solar facilities. Like all other renewable energy resources in mountain areas the visual impacts must be reduced and mitigated where possible but there is no getting away from the fact that we cannot expect to cheap clean energy without making sacrifices.

4.4.5. Solar derived energy and heat could be significant contributors to Europe's future energy map. To achieve this Euromontana suggests:

- Implementing financing programmes to pilot different scale installation and local networks in the mountainous areas of Europe.
- Initiating research into the improvement of the transfer grid and what will be required to integrate solar and other renewables energy within the minimum of lost potential
- Look at the potential for storage and transfer of solar derived energy within local networks initially to support local energy secure networks.

4.5. Wind energy

4.5.1. Wind energy is already widely used in Europe and in mountainous regions, especially in Spain and France, but also in Italy, Norway, and the United Kingdom. It has been spreading rapidly almost everywhere. **In the United Kingdom alone, production has been multiplied by a factor of 300 since 1990 and has tripled between 2000 and today. 25% of the power production (188 MW) has been installed in Scotland, in the Highlands.**
However, the installation of medium and large scale facilities (covering areas ranging from 6 to 25 km²) has been the source of a growing number of conflicts with local inhabitants, due to the impact that the facilities have on the landscape and environment in mountainous areas.

4.5.2. Whilst there may be environmental and landscape issues surrounding the development of medium and large scale wind energy facilities, Euromontana recognises that in many regions such issues can be satisfactorily resolved via the regulatory planning process. Given the potential of wind for future expansion it is recognised that the development of the wind resource at micro, meso and macro scale should be a key feature in any future European energy policy which is based on a mixed source approach

It is further recognised that the development of the wind sector in a mixed energy policy will benefit from further research into new technologies which could reduce the impact of such facilities on the environment and landscape.

4.5.3. Using wind energy to produce electricity, combined with solar energy to generate heat, could offer an ideal solution for mountain areas seeking to maintain their viability, a low-cost solution with no impact on the atmosphere. This could be especially useful for relatively inaccessible buildings (for ex., shepherds' cabins, shelters) where having access to electricity and heat could nonetheless be decisive in determining whether economic activity continues. This is particularly true of agricultural activity which, though it might appear marginal, is actually indispensable for life in mountain areas.

4.5.4. Example 4.5.3 show a use of wind energy as a method of supporting extremely remote dwellings in mountain areas. However, this is only one example of how mountain communities can use wind energy to provide for their own future energy security. On a larger scale, local wind farms have the potential to reduce mountain communities' reliance on externally produced energy and to contribute to the national grid systems to meet regional and national energy needs. Such schemes can vary in size but a good example would be the NOVAR Wid farm in Rosshire, Scotland.

The Novar wind farm is located in Rosshire on the hills of the Novar Estate. The site was commissioned in October 1997 and consists of 34 turbines, which produce a total maximum power output of 17MW. This can provide for the electricity needs of 3880 and 5146 homes per year. The wind farm covers 300 hectares of land at an altitude of 600m above sea level

but the actual turbines themselves cover only approximately 1% of that land area. The land itself is moor land and remains in use for the grazing of sheep and is also used for recreation by walkers and mountain bikers. Medium scale developments of this style can contribute significantly to a local energy network where other technologies and storage facilities are also used.

4.6. Geothermal energy

4.6.1. The term “high-temperature geothermal energy” (also called high-enthalpy geothermal energy) is used when there is a natural source of heat at ground level or below the surface, and low-temperature geothermal energy (also called low-enthalpy geothermal energy) refers to the use, via a heat pump, of the natural difference in temperatures between the surface and lower levels It is the least used source of energy in Western Europe, but it has attracted growing interest and has seen its competitiveness increase in recent years.
Looking beyond the use of thermal sources (which can be found in many of Europe’s mountain areas) for generating energy, low-enthalpy geothermal energy is at present the most widely available source of energy, especially for use in generating heat, and it can be integrated into other local facilities that rely on renewable energy sources.

4.6.2. Low enthalpy energy resources are currently being used in many communities across Europe to assist in domestic heating. This source of energy still requires more research to become more effective as part of larger scale models but clearly the technology is becoming more widely available and more efficient. The domestic uptake of ground source heat pumps and the improvements in their efficiency and availability all signify that this type of renewable energy resource is worthy of more studies and research and particularly in terms of scale.

4.7. Air Source Heat Pumps

Even cold air is full of energy and air source heat pumps use the freely available heat in the ambient air to provide efficient heating and hot water at air temperatures as low as -25°C. Because the source of heat – the air – is abundantly available, air source heat pumps have proven to be relatively cheap and popular around Europe. Coupled with the advantage of relatively low installation costs and minimal space requirements they continue to be used in many new dwellings and there is an established supplier market place. New generation air source heat pumps are even more efficient and commercial research continues to drive the market forward for better designs. Air source Heat pumps should be a seen not only as part of a domestic energy efficiency system but also for larger scale commercial and public building uses and particularly for public and community utilities.

Benefits of the outside air as a heat source

- Can be utilised all year round between +35°C and -25°C
- Always available and inexhaustible source of heat

- No requirement for the cost and land area of ground collectors
- Ideal for new build or retro fit applications, especially where space is limited

4.8. Energy Transmission and infrastructure

4.8.1. The current grid configuration in the majority of Europe was designed for centralised power production, mostly near to centres of population and energy demand. Reconfiguring the grid for a more dispersed form of energy production in different areas of the country will mean significant upgrades to the transmission and distribution grid systems. At present, grid systems around Europe are already operating close to there capacity which means that as more renewable energy schemes come on line there is either a long delay in getting access to a grid or in some cases there is no possible access. This problem is then exacerbated by the costs of connecting to the grid. As the grid was designed for production close to the user, the pricing system for connection is biased to those producers close to main urban population centres. For mountain based energy facilities, which by their very nature are at a distance from major cities and large population areas, this pricing system can be a barrier.

4.8.2. **Although Euromontana and many of it's members have no direct responsibilities for maintaining or developing the grid the current and possible future grid configuration is a key issue of concern within local mountain communities, and particularly for those who live near major high voltage grid routes. The grid can influence mountain areas in a number of ways:**

- In the short to medium term, the capacity of the grid determines the overall level of renewable energy developments that are viable;
- The grid's route and the location of its connection points will be a key factor in determining where renewable energy projects are feasible;
- The grid itself impacts upon the environment through which it passes and there are increasing demands for more sympathetic methods of construction to be used.

4.8.3. Euromontana believes that the grid should be seen as a means of facilitating renewable energy facilities development, but should not determine development potential and distribution in itself. As well as the issues associated with the grid, there are practical aspects associated with grid routing, capacity and upgrade potential. At present the grid network is saturated with existing demand and issued grid connections. In anticipation of future requirements for greater grid capacity, consideration should be given urgently to upgrading the grid network.

4.8.4. It is suggested that this existing network provides the most likely basis for any future enhancement works, the preferred method being to increase the capacity of existing routes, rather than develop new routes, whilst at the same time looking at the potential to develop local, regional energy networks that best suit mixed generation renewables. However, in considering future energy provision there is a need to look forward to new and improved ways of providing and using energy, rather than being constrained by systems established for energy sources in the past. Energy supply systems that are dispersed and low in resource requirements are likely to be preferable in meeting tomorrow's energy challenges.

4.9. Energy Storage

4.9.1. Due to the nature of human activities the demand for energy is not constant throughout the day. It is however generally predictable and can be met through base load generation combined with reserve generation that can meet the demands at peak periods. A growing reliance on intermittent generation (e.g. wind) means that long term predictions on supply are increasingly unreliable necessitating more contingency planning. Such contingencies include more reserve generation, expanded power networks (e.g. supergrids) and energy storage. The latter offers the best solution in terms of energy security and environmental impact as it makes best use of the local resources as opposed to increased reliance on external supplies.

Electricity storage

Numerous technologies have been developed to store electricity (hydroelectric, compressed air, flywheel, hydrogen, batteries, flow cells, superconducting magnetic energy storage).

The commercial viability of energy storage is highly dependant on numerous external factors (location, energy price, price variability, export tariffs, degree of sector integration, regulation, etc) but at present few of these technologies other than hydroelectric are economically viable without subsidy. However if additional benefits (e.g. portability, synergies) can be sufficiently valued there are opportunities in niche applications.

These solutions are typically proposed as solutions to intermittency (e.g. wind) and quality (e.g. loss prevention, digital demands) issues. However other propositions in remote regions can offer greater value depending on the potential user.

- At the utility level the application of energy storage offers the ability to defer costs on grid upgrade.
- At the individual level it allows the user to take advantage of excess electricity generated by micro-generation devices in the home without having to export to the grid.
- At the community level, energy excess can be similarly exported to the grid but there are potential advantages in utilising this at a local level. This could provide the energy to power fleets of electric vehicles or hydrogen powered vehicles.

4.10. Research opportunities

While there is scope for further R&D to address technical challenges and drive down costs in each of the storage areas the most value for remote regions would be in the understanding the optimal arrangement of generation and storage to suit the particular circumstances and surroundings. The creation of a flexible socio-economic model which accurately captures the numerous external factors would provide a tool for communities to make an informed choice and either stimulate the energy storage market or highlight the barriers to its application.

4.11. Conclusion

4.11.1. **Energy self-sufficiency, diversification of revenue sources and active, sustainable exploitation of resources are achievable in mountain areas of Europe across a wide range of natural resources.**

The expertise, technology and community leadership of the development of renewables energy generation are both present and well advanced. All of these factors highlight the importance placed on renewable energy by mountain communities and their enthusiasm to maximise their potential.

However**, Euromontana also recognises that more support can be given to the mountain communities who are striving to become leaders in the renewable energy sector.**

4.11.2. **Euromontana supports the idea that mountain regions possess a range of resources that can be used to generate energy individually and in mixed generation models and at smaller scale for local use and medium to large scale for exports specific to mountainous regions.** Their use should be managed principally by the institutions that represent those areas, and which should determine, in agreement with other users, the terms defining the mix of, and preference for, the use of specific resources, the scale of production and the distribution of the energy generated.

4.11.3. **The combined use of energy resources in small/medium scale systems** (hydroelectric, small wind turbines, local photovoltaic and solar heat systems, small biomass power plants, heat pumps that utilise low-enthalpy geothermal and air source energy) **can contribute to the development of renewable resource energy production and distribution models, available in mountain regions.** Supporting and encouraging mixed resource, small scale energy systems as pilots for larger scale implementation can help accelerate our understanding of integrated systems whilst at the same time having immediate beneficial impacts on both CO2 emissions and the economics of remote and peripheral communities.

4.11.4. **Euromontana supports** the development of storage technologies for energy producing communities and recognises the need for **a programme of projects that investigate the potential models of generation and storage to maximise the energy potential of mountain communities**

4.11.5. **Euromontana supports improving the profitability of energy and the extra revenue for rural and mountain communities that this can offer.** This allows them to build a more efficient partnership with investors for environmentally and economically sustainable development in the future. This will make it easier to reach **the goal of energy self-sufficiency for rural population centres.**

5. Towards a systematic vision: Environmental and Energy Certification

5.1.1. Euromontana would like to suggest combining the search for new technologies using renewable energy sources – and in the medium term, the use of other available resources – with environmental issues and transport policy, with a view to realising the « systemic » integration of the following: urban centres and the surrounding areas in mountainous regions, waste management, the fight against air pollution, ecosystems. Environmental certification must include energy certification.

5.1.2. The theme of energy is inevitably connected with and structurally linked to other essential themes related to development and life in mountainous areas. All the other themes, from the environment to transportation, including current and future economic activity (*with special attention being devoted to SME*s), must be considered in terms of their energy efficiency and the development of the use of renewable energy sources A systemic framework means that each element will be considered in relation to the others and the effects of an action on one element will be evaluated by considering the consequences on the system as a whole. In this manner, it is possible to optimise the consumption and use of energy sources (for ex., hydroelectric generation within the water « system »).

5.1.3. The "City of Energy" quality label, adopted by Switzerland in 1997, and then extended to Germany and Austria within the framework of the EEA (*European Energy Award*), is an example of an effective concrete policy to raise energy awareness among citizens and local institutions. To present, this kind of certification is the only example that comes close to the integrated and systematic approach to energy use in a region such as that suggested by Euromontana. An additional research effort is therefore necessary at the European level if we are to establish a new model of certification that can be extended to all the parts that influence each other.

5.1.4. There are production quality certification systems, though they should address all types of production (water, biomass, etc.). Euromontana requests that **these certification systems be systematised and regulated so that results obtained in different areas are comparable.**
For instance, in the Scottish Highlands, the demand for internationally recognized certification for the installation of wood heat power plants is on the rise, especially in the residential market. The need for training has been acknowledged, and courses have been organised, but this has not been done on the basis of an internationally recognized standard. In principle, this standard should be tied to the efficiency of the heating systems, with special attention given the amount of CO2 emitted into the atmosphere.

Final recommendations

Signed by the President of EUROMONTANA in Chiuro (Sondrio, Italy) 20 November 2009

Mountainous areas are energy producers from a mix of resources and wish to negotiate the use of these natural resources with a greater amount of **equity.** In particular, a firm policy that **considers all mountain energy resources as vital to the future of our energy matrix** needs to be established. renewing and modernising our existing energy producing and transmitting infrastructures and making them more efficient, giving fair compensation to areas taken up by energy facilities, ensuring a new *"governance"* between central governments local and territorial entities (for ex. the « massif policies » developed in France).

The mountains have a special status as observatory and laboratory of climate change, and they have solutions to offer Europe. Our mountain areas are already experiencing the changes in climate that are changing the way of life and the economy of mountain communities. As sad as this may be, Euromontana encourages the European Union to take advantage of this and invest in mountain communities now. Not only for their own survival but as a place that allows the rest of Europe and the world to develop workable adaptations to the problems of living with climate change.
The mountainous regions are therefore a high-priority stakeholder in the Europe's discussions on energy policy and they propose nine basic concepts to develop and encourage a specific energy policy at the level of the European institutions over the coming years:

1. Energy savings

"Lowering consumption while increasing quality of life"
Energy savings is most definitely the cleanest and most available energy source. They help lower the production of CO2, and therefore pollution, and reduce the dependence of European regions on countries that produce fossil fuels (oil, natural gas) which are almost all located beyond Europe's borders.

Mountainous regions can make an important contribution toward realizing the EU's 20-20-20 objectives – given that energy consumption by buildings accounts for nearly 40% of total consumption – especially through **new construction and home concepts for mountainous areas** (the use of traditional materials, as well as « smart buildings » and home automation), **taking a fresh look at the landscape of long-inhabited population centres – which are often naturally energy efficient (the historical population centres of mountainous regions can also serve as a model for the construction of new buildings). Mountain regions can also contribute by encouraging local businesses, especially small and medium-sized enterprises, to rethink their manufacturing processes, in order to improve their energy efficiency.**

2. Area surveys and energy cadastres

The mountainous regions want to set an example for the rest of Europe: area surveys, analysis of energy needs and available resources, and optimisation of consumption. Area surveys must result in an evaluation of the population's energy needs, and in an evaluation or the area's potential for supplying resources that can be used to produce energy. For each part of an area, it is important to evaluate consumption patterns and its potential to furnish energy. In the resulting area **« energy cadastre »** all processing activity is evaluated according to its « energy footprint », with reference to resources available in the area or nearby. Activities can be given a greater or lesser degree of encouragement from the authorities, and, in addition, an incentive policy based on issuing building permits could be developed. This idea is already being tested in some parts of Europe's mountain regions, and could be extended to all of them.

3. Natural resources shall be properly compensated

Mountain regions are not always properly and equally compensated for the use of this resource. Euromontana demands that the local or region authorities receive compensation for the use of all natural resources used in power generation. Price setting must be negotiated within the framework of a political process. This demand is in compliance with some national legislation, and with article 7 of the Energy Protocol of the Alps Convention.

4. Combined natural resources produce energy and revenue

"Energy self-sufficiency, Diversification of revenue sources, and Export of Energy"

An Integrated approach to the generation of energy from mountain natural resources is vital for the future of mountain areas. Each of Europe's mountain areas has available to it a varied mix of resources in different volumes and therefore a varied capacity to capitalize on the maximisation of these resources. It is therefore vital that a fully integrated approach to energy sources is at the heart of any future strategy for the development of renewables energy production in the mountains. This approach should also fully support the principles of energy self sufficiency, diversification of revenue sources for mountain communities and the opportunities for mountains to become quality exporters of clean energy.

To achieve this goal **all renewable energy resources should be supported equally** and each competent authority should be encouraged to identify the resources and their balance that best meet it's future needs. At the same time and using the huge experience the mountain regions of Europe have in the use of clean energy sources, research should be encouraged into not only the technologies needed to generate energy but also the models of energy resource management, energy transmission and energy storage.

To enable mountains to become quality energy suppliers to other regions of Europe connectivity and

transmission systems need to be reviewed and evaluated and new systems researched, studied and tested where appropriate. Supplying energy has the potential to become a significant economic factor for many mountain communities in the future and at present it is recognised that the current energy transmission systems may be a major barrier in this future being realised. It is therefore vital that mountain areas are supported in working with non-mountain areas to develop future transmission systems that enable the most efficient use of mountain resources to benefit users around Europe.

The realisation that renewable energy resources have peaks and lows in their possible production levels, whilst being one of the key reasons for mixed and integrated production systems, also raises the issue of storage potential so that mountain communities can store surplus energy for use or export at a later date. Current technologies are limited but research into storage systems and fuel cells is taking place around Europe. Support is required to encourage more research into the technology solutions and to initiate pilot projects in mountain areas where some of the greatest energy challenges currently exist. This approach also needs to consider the full range of energy uses including transport where fuel cells charged from renewable resources are a key area of current research and studies.

Water is one of the most important natural resources that mountain regions possess. Hydroelectric power generation expanded greatly over the course of the last century, and up until the 1950s it was the most important source of energy in Europe. Producing energy from **biomass,** especially from wood and its by-products, can help eliminate waste from the agricultural and lumber sectors while producing electricity and/or heat energy, thus reducing dependence on fossil fuels such as oil. Planting trees for timber is playing an increasingly important role in reducing pollution and carbon dioxide in the atmosphere.
Using **wind** as power source also has a long history in Europe. Many regions now have a significant wind energy industry and the mountains of Europe possess some of the foremost examples of modern wind energy production. **Solar** energy has become more common in small scale and domestic energy saving solutions. Mountain areas again possess one of Europe's best solar resources. **Geothermal** energy sources are becoming more popular in domestic and small scale energy systems and more work is being undertaken to maximise this energy resource in remote mountain communities.

The combined use of energy resources in small scale systems (hydroelectric, small wind turbines, local photovoltaic and solar heat systems, small biomass power plants, heat pumps that utilise low-enthalpy geothermal energy) **can contribute to the development of renewable natural energy resources, available in mountain regions, and leading to a sharp decline in the use of fossil fuels. Supporting and encouraging mixed resource, small scale energy systems as pilots for larger scale implementation** can help accelerate our understanding of integrated systems whilst at the same time having immediate beneficial impacts on both CO2 emissions and the economics of remote and peripheral communities. It is important to recognise that mixed generation systems are not just for small scale production. The small scale pilots can be used to expand our knowledge and understanding of operating multiple energy resources to generate consistent energy flows at all levels, including the export of energy.

Euromontana holds that the profitability of energy, and the extra revenue for rural communities allows them to build a more efficient partnership with investors for environmentally and economically

sustainable development in the future. This will make it easier to reach **the goal of energy self-sufficiency for rural population centres and the goal of economically supporting, through the open electricity market, rural enterprises** and the energy security of the mountain communities and the rest of Europe.

5. Quality certification to consolidate processes

Euromontana suggests a systemic framework for the energy policy of mountain areas, which means considering each element in terms of the others and evaluating the effects of an action on one element by considering the effects this could have on the system as a whole. This is the only way that consumption and the use of energy resources (including renewable energy sources) may be optimised. What we are referring to here are environmental issues and policies regarding transportation, urban centres and the surrounding areas in mountainous regions, waste management, the fight against air pollution, ecosystems. **Environmental certification must include energy-use certification**, on the basis of trials currently under way in some European countries, and more specifically those being conducted in mountainous areas, so as to move towards a framework of « total » quality when defining and implementing environmental and energy policy, and to make progress toward continuous improvements in technology and manufacturing processes.

6. Training

A detailed knowledge of the processes involved in area energy Cadastres, savings strategies, and the proper use and management of available resources should be shared by all operators. **Training tools need to be made better-suited toward the creation of a common standard at the European level** and to train above all the sector's technicians, entrepreneurs, and local entities. A reasonable credit line should be established for all the initiatives that aim to define and unify these standards at the level of Europe's mountain regions.

7. Sharing information

Achieving the 20-20-20 objectives set by the European Union is within the reach of Europe's mountainous regions. The people who live in those areas already have a number of assets at their disposal, by virtue of the construction materials and resources they have. In order to make good use of these assets, they need to be kept informed of changes in regulations, tax matters and available sources of financing, as well as being made aware of technologies that offer greater energy efficiency (construction methods and advanced techniques for monitoring consumption). The European Institutions must encourage in all ways possible the creation of information networks and centres in mountain areas, where the authorities also work to narrow or bridge the digital divide.

8. Energy desks at the municipal level

Spreading concrete policy actions in the area of energy savings and those encouraging the use at the local level of naturally available energy sources can only happen by sharing information with professionals and citizens via information and technical assistance centres. These kinds of centres already exist in some municipalities. Euromontana suggests that this principle be extend, with local centres in town halls providing a first response to the needs of citizens. Mountain municipalities – and possible all the others as well – must also be able, through appropriate EU credit lines, set up their own « energy desks » where citizens can go at any time to learn more about energy savings and the proper use of energy resources, develop projects, and apply this knowledge on the basis of their own individual and unique circumstances, the location of their home or place of business, and the savings goals that could reasonably be reached.

9. EU credit lines

Euromontana specifically suggests that, **starting in 2011**, the European Union's budgeting process include **specific strategies in the areas of energy savings; setting up Energy Cadastres; developing renewable resource energy generation technologies; a systems approach (and « broader » Environmental Certification); improvements in both the scale and the economics of the transmission grid; the development of storage technologies and models to complement a mixed generation system; with a view to conducting pilot studies and experiments in the area of mixed and balanced energy resource models, quality control processes and the supply and sharing of energy resources that will follow, and to share best practices already in place in other parts of Europe.**

The mountain regions of Europe would hope to see some of the above strands of financing focused on rural and mountain regions where the greatest potential of onshore resources exist. Establishing new funding programmes (or adding specific priorities to existing programmes) with specific geographic or territorial restrictions would help those areas which, despite the abundant resources, often receive less financial support to develop a sector which is an area of expertise and a future source of economic well being.

It will therefore be necessary to take action at the legislative level as well as in the cultural and social spheres, from the European parliament to the smallest local communities, so that new funding initiatives, whether wholly or partially related to the issues raised in this Position Paper as regards the mountainous areas of Europe, may be put forward and supported.

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