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Pilot study

Climate neutral Alpine Region 2050

Summary for Policymakers

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Summary for policymakers

Table of Content

1	Summary	3
1.1	Background: Decision of the 10 th Alpine Conference	3
1.2	Structure and questions of the pre-study	3
1.3	Conclusions of the expert hearing and the pre-study	4
1.4	List of experts	7
2	General scope and target of climate neutral Alps	8
3	Main energy using activities	11
3.1	Buildings and construction	11
3.1.1	Scope and boundaries	11
3.1.2	Targets	11
3.1.3	Implementation	12
3.2	Energy	12
3.2.1	Scope and boundaries	12
3.2.2	Targets	13
3.2.3	Implementation	14
3.3	Transport	15
3.3.1	Scope and boundaries	15
3.3.2	Targets	16
3.3.3	Implementation	16
4	Main economic fields	19
4.1	Land use, agriculture and forestry	19
4.1.1	Scope and boundaries	19
4.1.2	Targets	19
4.1.3	Implementation	20
4.2	Tourism industry	21
4.2.1	Scope and boundaries	21
4.2.2	Targets	22
4.2.3	Implementation	22
4.3	Other industries, services and commerce	23
4.3.1	Scope and boundaries	23
4.3.2	Targets	24
4.3.3	Implementation	24

5	Spatial planning and institutions as enabling factors	26
6	Institutions	27
6.1	Scope and boundaries	27
6.2	Targets and Implementation	27

1 Summary

1.1 Background: Decision of the 10th Alpine Conference

Coping with climate change is most probably the largest challenge for our societies over the coming decades (cp. IPCC 2007).

The Alps as a unique habitat are particularly challenged by the threats of man made climate change. Not only the extraordinary variety of ecosystems but also the high exposure of crucial infrastructures to changes in the natural environments highlight this fact. Furthermore, recent climate research shows that the Alps are predicted to experience significantly higher temperature increases than other parts of Europe.

With this background the 10th Alpine Conference adopted a Climate Action Plan with the target to make the Alps a forerunner for climate mitigation and adaptation. With this background it decided to conduct a study “How the Alps can become climate neutral by 2050”.

In order to enable a sound decision on this study at the Permanent Committee in October 2009, Germany decided to finance a brief Pre-feasibility study on this issue and commissioned the Wuppertal Institute for Climate Environment Energy for the conduction of the pre study.

1.2 Structure and questions of the pre-study

As a means to further analyse the given target to further evaluate how the question of the envisaged study “How the Alps can become climate neutral by 2050” could be further operationalised and what should be scope and targets of this study the Wuppertal Institute conducted three main steps:

As a start the vast range of **the topic of climate neutrality was clustered** to three generally overlapping dimensions with three main topics each.

- The first dimension comprises the three main energy consuming and GHG emitting sectors
 - Buildings and construction
 - Energy and
 - Transport.
- The second dimension consists of the main economic fields and activities responsible for a huge share of GHG emissions. These are
 - Land use, agriculture and forestry,
 - Tourism industry, and
 - Other industries, services and commerce.
- The last dimension covers the cross cutting issues such as
 - scenario and targets,
 - spatial planning and
 - institutions.

Based on the clustering of the topic **a list of relevant experts from the Alpine region was set up**. This list consists of experts on one or more of the relevant clusters with both a professional Alpine background and a significant knowledge and track record in climate and global change issues. Recommendations for the list were acquired from the secretariat of the Alpine Convention, from ISCAR, CIPRA, BMU and from WI contacts. In order to safeguard the suitability of the experts proposed a short list of experts with double recommendations was refined. Based on this short list experts were invited to an expert hearing conducted at the 2nd of September 2009 in the premises of the Bavarian State Ministry on Environment and Health. For this hearing experts were invited in a manner to have two experts for each topics of dimensions one and two as well as two experts on the overarching dimension three. The experts were also selected to cover all countries of the alps with at least two experts. As a total 15 experts from all Alpine countries took part in the discussion at the hearing and provided prior written input to a set of seven questions sent to them in advance.

At the **expert hearing which served as the core of a pre-feasibility study** the following main questions were discussed:

- What shall be the scope of the main study on climate neutral Alps? How can the concept of climate neutrality be operationalised for the Alpine region and for the specific sectors? What might be appropriate boundaries by sector?
- What would be an appropriate target for the Alps (by sector) to be further substantiated in a main study? What would be important features to make the concept of climate neutral Alps really a forerunner?
- How can the concept of climate neutrality be implemented in the alpine region and which preliminary steps of implementation could already be incorporated into the main study?

Based on the written inputs, the presentations hold and the results of the discussion the conclusions documented in the following chapter were drawn up during the hearing¹.

Annex I to III contains the original powerpoint presentations and background paper by the Wuppertal Institute as well as the detailed inputs provided by the experts.

1.3 Conclusions of the expert hearing and the pre-study²

Currently no clear numbers on the GHG emissions and the resulting “climate balance” of the Alpine region are available. However, existing rough estimates indicate that today on the Alpine territory about 100 Mt of CO₂ are emitted annually. This would result in a value of 7.4 t for each of the 13.6 million inhabitants. Analyses for the city of Bolzano (IT) show a comparable value of 6.6 t per capita. However, grey energy – as indicated from international

¹ The conclusions were intensively discussed at the meeting and were generally shared by virtually all of the experts. However, the responsibility for the conclusion remains with the Wuppertal Institutes, as there has not been conducted a process of formal endorsement by all experts. The list of the experts as well as their individual contributions are fully documented in the annex to the pre-study by the Wuppertal Institute.

² The following conclusions significantly draw on the information provided by the experts.

studies – may well add to this with several tons per capita of indirect emissions related to the goods and products consumed in the Alpine region.

This amount of GHG emissions is far from being climate neutral. As current research clearly indicates GHG emissions should come down by the mid of the century to values of 2 tons of CO₂ equivalent per capita³ or even lower values. Recent research also makes it very clear that the shape of the reduction curve matters. The faster these reductions take place the higher is the chance to contain GHG concentration at a level compatible with the 2°C warming target.

Furthermore, current research points to the fact that Alpine agricultural and forestry land as well as the Alpine wetlands are a potentially growing stock to huge amounts of stored Carbon. The annual uptake is still highly unclear. Specualtions range from more than 10 million tons of CO₂ up to more than 50 million tons per year. This puts a specific challenge to the topic for the Alps. Maintaining this stock of stored carbon could prevent a huge amount of additional greenhouse gases to be emitted into the atmosphere.

As a whole the Alps represent an special and endangered international eco-region. They are not only highly threatened by climate change but also form a potentially unique reservoir of carbon stored. A protection of this cultural as well as carbon heritage should be a central motivation for to create a pan-alpine climate stability eco-region. The study endorsed by the 10th Alpine Conference could further evaluate the significance and the prospects of such an example.

On the necessity of a main study the following **core conclusions** can be drawn:

- **The topic of “How to become climate neutral” is regarded to be highly relevant and important** as well as very urgent, given the size of the global challenge and the emergency of significant action.
- Specifically for the Alps not only the potentially significant threats for human and eco systems are at stake but also the functioning of the Alps as a presumably significant common CO₂-sink. **The challenge not to loose this sink function and to prevent the huge stock of stored carbon in Alpine eco systems** should be a major motivation to analyse the issue of climate neutrality particularly in the Alps as a common task for the 8 Alpine countries.
- **A comprehensive and cross-disciplinary main study is needed** to better structure the topic and to improve on the significant data gaps existing in almost every thematic cluster. It should, however, balance data needs and the necessary effort for data generation in a pragmatic way.
- **The Alps do have a couple of assets which put them into the position to obtain a forerunner role.** These should be evaluated and further analysed in the main study. Such a study should be implementation oriented and targeted at actively contributing to develop the Alps as a forerunner in those fields where they have particular potentials for action.

³ This value can be derived from the position of the EU environment ministers published in December 2008.

The scope of the main study should be structured alongside the three dimensions and nine topics identified by the Wuppertal Institute and follow the four principles:

- **Inclusive**, i.e. cover GHG emissions on the territory, GHG emissions embedded in products and services used in the Alps and include potential mitigating effects of alpine goods and services outside the Alps.
- **Target oriented**, i.e. oriented at the target to achieve climate neutrality by 2050 and ultimately climate stability in the Alps, in Europe and globally.
- **Forward looking**, i.e. by assuming offsets only as a limited potential for mitigation, not as an excuse for business as usual in the region itself and within a truly advanced and ambitious framework.
- **Flexible**, i.e. taking into account the specific situation, data availability and potentials for action of Alpine actors in every thematic cluster, boundaries should be flexibly defined by cluster.

Appropriate targets to be further analysed and which offer options to obtain forerunner positions should be:

- **Climate neutrality should be understood in a strong sense in the main study**, i.e. as a first step towards a climate stability target combined of adapted targets per thematic cluster. In this context also very ambitious targets could be analysed (e.g. renewable energy autonomy plus potential exports from the Alps, an active role in the development of a Pan/European renewable electricity system, optimisation of the net sink function of soils, analysing significant changes in Alpine economy and provision of climate neutral goods and services to the Alpine population and tourists and potentially for exports).
- Overall it might turn out to be appropriate to use a **combination of a comprehensive approach and exemplary approaches in the main study, depending on the very thematic cluster and the data availability as well as the potentials for action for Alpine actors**. The main study should thus focus on fields/sectors where mainly municipal and private groups in the alps have potentials to act. It should analyse concepts for a „100% best practise“ approach i.e. making current good or best practise standard everywhere in the Alps and it should retrieve ideas for the Alps to assume a forerunner position and provide good example for other regions.

Approaches for the implementation orientation could be:

- **To make 100% best practise minimum standard**, e.g. analysing approaches to disseminate and broadly implement best practises in tourism, building, energy etc. by developing networks, benchmarks, competitions etc. for dissemination discussing and proposing municipal instruments to support and direct action towards 100% best practise.
- And to **empower local and regional administrative and planning capacities to become facilitators and actors of change** – also as an example for the Alpine countries. Here proposals should be developed on how to enable local and regional administrations to implement stronger strategic thinking and action and to better

enable them to take up a forerunner role with regards to implement ambitious standards Further the creation of new regional actors as change agents for combining local organisations could be analysed.

1.4 List of experts

The following experts actively participated in the expert hearing on the 2nd of September in Munich and/or provided written input. Annex III contains the expert contributions in form of the original powerpoint presentations as well all written inputs. The authors would like to thank all experts for their commitment and their excellent input to this pre-study. All errors as well as the conclusions drawn remain in the responsibility of the authors.

Cluster	Name	Country
Building and construction	Prof. Dietrich Schwarz	Liechtenstein
	Dr. Marco Keiner	Switzerland
Energy	Prof. Gian Vincenzo Fracastoro	Italy
	Prof. Francesco Martelli	Italy
	Dietmar Überbacher	Italy
	Andrej Klemenc	Slovenia
Transport	Prof. Dr. Hermann Knoflacher	Austria
	Florian Lintzmeyer	Germany
	Willi Hüsler	Switzerland
Tourism	Prof. Dr. Jean Paul Ceron	France
	Prof. Dr. Felix Kolbeck	Germany
	Prof. Dr. Thomas Bausch	Germany
Land use and food production	Dr. Mojca Golobic	Slovenia
	Prof. Dr. Carmen de Jong	France
Industry	Dr. Fritz Hinterberger	Austria
Planning	Prof. Peter Droege	Liechtenstein
	Helmuth Moroder	Italy

2 General scope and target of climate neutral Alps

The target of studying climate neutrality has been set by the Alpine conference. From this background two general questions arise:

- How has the term climate neutrality to be defined in terms of ambition of the target?
- And: What falls under the scope of the target?

Both questions will be discussed in the following sections with regards to the 6 most relevant clusters identified in our pre-study.

Target

As appropriate targets to be further analysed and which offer options to obtain forerunner positions we could identify the following two main principles:

- Climate neutrality should be understood in a strong sense in the main study, i.e. as a first step towards a climate stability target combined of adapted targets per thematic cluster. In this context also very ambitious targets could be analysed (e.g. renewable energy autonomy plus potential exports from the Alps, an active role in the development of a Pan/European renewable electricity system, optimisation of the net sink function of soils, analysing significant changes in Alpine economy and provision of climate neutral goods and services to the Alpine population and tourists and potentially for exports).
- Overall it might turn out to be appropriate to use a combination of a top-down and more exemplary bottom-up approaches in the main study, depending on the very thematic cluster and the data availability as well as the potentials for action for Alpine actors.

Definition

How could a scenario on a climate neutral Alpine Region be properly defined? At first a general decision has to be taken whether the scenario should be top down rather comprehensive, including all relevant activities and GHG or rather bottom up with a focus on specific actions in selected clusters like tourism where a forerunner role of the Alpine Region would be self-evident.

The following chart provides a first structuring of the topic of climate neutrality for the Alps.

Possible definitions for scenarios of climate neutrality

		Principles for Definition					
Sectors		Territorial		"consumer responsibility"		"supplier responsibility"	
		Pure	Flexible Mechanisms	Direct Energy Demand	Including Products and Services	mitigation on the territory	mitigation on and off territory
Comprehensive vs. Exemplary Approach	Energy	GHG Emissions from Fuel Use on the Territory + Process related GHG		Energy Supply	+ GHG Footprint of Imported and Exported Products (Related to Consumption in the Alps)	Mitigation Effect of the Use of "Climate Neutral" Energy, Products and Services Demand of "Climate Neutral" Energy, Products and Services	
	Households			Energy Demand			
	Services			+ Process Related			
	Industry						
	Transport						
	Land Use & Agriculture	Fuels Use Other GHG & Sinks		Energy Demand Other GHG & Sinks			
	"Rest of the world"	-	Supply of GHG Emission Certificates	Energy Export Balance	+ GHG Footprint of Exported Products	Supply of "Climate Neutral" Energy, Products and Services	+ Imports of "Climate Neutral" Energy, Products and Services

The vertical division into sectors given in the table above is due to statistics. Other dimensions are thinkable

A second general decision is related to the question to whom GHG emissions should be imputed.

- Applying the Territory Principle GHG are assigned to the territory (its inhabitants respectively) where the GHG are emitted. So the location where fuels are burned or GHG are released in the context of industrial processes or agriculture is decisive. Mobile sources like cars are treated differently: Here usually the location where the fuel is sold is decisive.

Climate Neutrality in the context of the territory principle means that emissions and sinks on the territory are balanced. Flexible Mechanisms offer some flexibility for inhabitants of one territory to realize GHG elsewhere (and be credited for it) but furthermore to realize negative emissions.

The Territory Principle is a quite pragmatic way to assign GHG but not always satisfactory as GHG are assigned to physically emitting activities but not to due to responsibility.

- The Principle of Consumer Responsibility assigns GHG due to the triggering demand. Direct energy demand as the trigger of energy related GHG emissions is used in energy statistics to allocate GHG more suitable among sectors but also among national economies. So the amount and the quality of energy (in respect to its GHG footprint) consumed in the Alpine Region would be decisive for its GHG balance and not where GHG are emitted.

A wider approach would also take into account the footprints of imported and exported products and services. Footprints of imported products would have to be assigned to the Alpine Region, whereas footprints of exported products would be assigned to the importing economy.

- The Principle of Supplier Responsibility is not appropriate to account for total GHG emissions but reveals mitigation effects of the use of “climate neutral” products in relation to a virtual situation where “conventional” products would be used. This concept addresses producers of goods and services in the Alpine Region. To bring the Alps into a forerunner position Alpine companies would have to excel their business rivals abroad regarding the carbon footprint of their products.

Applying this principle it is quite logical to take mitigation effects outside the Alpine Territory also into account. E.g. an Alpine Tourism concept that attracts visitors from nearby who would have otherwise made journeys with much higher climate impact, could be counted here. However from a methodological point of view this concept is not easy to include into an overall regional balance – mainly due to the problem of finding a due baseline for determining the alternative (In this example of travelling to the Alps.).

3 Main energy using activities

3.1 Buildings and construction

3.1.1 Scope and boundaries

- The building and construction sector in substance comprises the **sub sectors** heating, cooling, electricity demand for households, decentralised electricity production and grey energy.
- The main focus of the building and construction sector shall be the development of sustainable decentralised heat supply systems and infrastructures on the one hand and energy efficient buildings and household appliances (as well as e.g. office appliances) with very low heat and electricity demand on the other hand.
- There are mainly three overlaps with other sectors: Firstly, the process heat and cold should be dealt with under “industry and commerce”. The second overlap, the electricity generation, originally concerns the energy sector. But it also matches to the building sector, especially if electricity is generated decentralised by CHP and/or renewable energies directly linked to the building or dwelling areas (e.g. solar roofs or small scale wind turbines). Further, decentralised heat and cold supply are mainly dealt with in this cluster but can be seen as well as parts of the energy system.
- Another sub sector of buildings and construction could be so called “grey energy” that describes the energy requirement for the production, usage and disposal of any product within its life cycle (“from the cradle to the grave”).
- For all sectors it is valid, that the idea of “climate neutrality” does not comprise only “carbon neutrality” but also has to include other relevant greenhouse-gases (GHG) of direct and indirect emission related to the regarded product or service.

3.1.2 Targets

- The overall target for the buildings and construction cluster could be to minimise energy demand and maximise renewable energy supply of buildings under consideration of traditional and cultural aspects in the Alpine region. This could be achieved by:
 - New buildings only in passive house (later: plus-energy) standard and utilisation of local renewable energies (100% in new buildings).
 - 100% energetic refurbishment of buildings
- Supporting instrumental targets would be:
 - Capacity building for architects, supply engineers and other professional planners (training and certification). The aim has to be that all technical colleges and universities in the alpine region must bring (economical, social and ecological) sustainable construction as principal design subject into the architecture courses and curricula.

- The development and broad implementation of “regional master plans for heat supply” by constitution of stakeholder and specification of the contents

3.1.3 Implementation

- Introduction of an area-wide uniform energy pass for buildings to obtain energy cost transparency for tenants and real estate buyers on the one hand and to collect data of building substance on the other hand.
- Implementation of decentralised building ordinances that request passive house standards from all buildings.
- Local networks to develop high market shares of plus energy buildings (e.g. like the Vorarlberg example), networking of construction companies, craftsmen etc. to convert building industry and safeguard the respective quality.
- Local schemes to refurbish existing buildings with local know-how building.
- 100 % decentralised energy supply to alpine dwellings by local heat networks or other forms of local energies.
- Creating of conditions and incentives that would encourage stakeholders to jointly and more actively pursue sustainable building and construction from a life cycle perspective:
 - Governmental policies, economic incentives, rating systems, coordination with key partners (e.g. in financing and insurance sector).
 - Identification and promotion of best practices through community networks (such as CIPRA, Climate Alliance and others) and the media
 - Creation of a network of architectural and planning faculties and technical schools for building professionals to further strengthen low emission architecture and planning.
 - Creation of a municipal network of voluntary agreements to convert all public building to passive or plus energy standards.

3.2 Energy

3.2.1 Scope and boundaries

- The energy sector in substance comprises of the following **sub sectors**:
 - Power
 - Heat and Cold

- Transport (Energetic aspects of transport are dealt with separately in the transport chapter⁴.)
- The supply of heat and cold overlaps with the building cluster and is discussed there with the exception of combined heat and power production (CHP)⁵.
- The **power sector** remains as the key element of the energy sector for the Alpine region. As a further demarcation the power sector is characterised more centrally, while the heat (and cold) supply of buildings is more distributed.
- Another sub sector of energy could be so called “**grey energy**” (“energy footprint” or “embodied energy”). The term describes the energy requirement for the production, usage and disposal of any product within its life cycle (“from cradle to grave”). In a “Climate neutral Alps main study” the life cycle energy for energy products like wind power (including production, erection, operation and disposal of a wind mill) should be in the scope whereas the grey energy of non energy products (e.g. consumer goods) rather could be estimated aggregately.
- It is difficult to draw clear boundaries for the ecological assessment of the electricity production and consumption in the Alpine region.
- There are two different approaches for the ecological assessment:
 1. Analysis of the power production of the Alpine region minus the net power export (possibly as an offset of emissions because it might reduce GHG emissions from alternative electricity generation). However, this setting of boundaries will cause two major problems: First there is a significant exchange of electric energy between the Alps and other regions (see Annex 1) which is oversimplified by the net export concept. Second, lots of the alpine hydro energy is already sold as “green electricity” into the EU market⁶. If the purchasers of this electricity take it into account as own emission reduction this would lead to an overall double counting.
 2. Analysis of the central Alpine electricity generation as it was part of the European power production portfolio – what it de facto is. In this case the emissions for electricity should overall equal the EU average.

3.2.2 Targets

- Globally reductions of GHG emissions by 80 to 90% by 2050 (vs. 1990) are necessary in the industrialised countries. Due to its low population and industry density and due to its high RE and energy storage potentials the Alpine Region should exceed this target in the energy sector to be regarded as a real forerunner.

⁴ With increasing use of electricity in the transport sector the links between both will increase in the future.

⁵ Respectively tri-generation (combined heat and cold power production).

⁶ In fact also the power plants themselves often also belong often to non-Alpine actors, e.g. the electricity companies of Zurich and Munich.

- Moreover the renewable energy production has to compensate most probably also emissions of other sectors with lower potential for emission reduction (like the transport sector).
- The Alpine region should aim at a renewable power production of more than 100 % related to the domestic power demand.
- Furthermore, in the near future the Alpine region should play – together with similar advantaged regions like Norway – an important role in the field of integration of big amounts of fluctuating wind and solar power into a further improved trans-European electricity network.
- Assessment of “grey emissions” is very complex. However, balancing the emissions and the grey energy correlated to power production (e.g. one kilowatt hour of wind power) is state of the art and thus should also be taken into account.

3.2.3 Implementation

- Extension strategy for all renewable power generation sources, especially from biomass, solar (photovoltaic) and wind where possible. For these the status, regional potentials, targets and intermediate targets (roadmap) should be analysed and determined. To gain maximum acceptance projects should be realised under participation of involved residents and under consideration of ecological, cultural and social issues. At the same time the (climate protection) urgency should be communicated to create awareness for the need of prompt local action and to avoid possible “not in my backyard” effects.
- Extension strategy for power storage potentials and services. As described above this strategy should base on a shift from a seasonal to a weekly and daily operation strategy, by an extension of pumps’ and turbines’ capacities (with new water management beneath at the same time) and on a shift towards grading-up non-dispatchable (fluctuating) wind and solar power from the European network instead of non-dispatchable conventional base load power.
- Efficiency strategy in any element of the supply chain. In this field different measures from information campaigns up to the establishment of regional power saving funds are suitable. Giving incentives for the purchase of highly efficient electric domestic appliances (e.g. refrigerators with class A++ standard) and public procurement of energy efficient devices are further examples for pushing energy efficiency on the demand side. To monitor the success of these measures quantitative targets (like minus x % per year in power consumption) for the Alpine region could be set and reviewed in certain periods.

3.3 Transport

3.3.1 Scope and boundaries

- The main differentiation of transports is between passenger and freight transport. Referring to the traffic flows, as the main difference, it can be stated that passenger transports normally are conducted in a symmetric shape, i.e. from A to B *and* from B to A, whereas freight transport normally proves directional, i.e. from A to B *and not* back.
 - For passenger transport a main differentiation might be between persons, whose normal residence is within the Alp region and those living normally outside the Alp region, primarily the tourists.
 - Freight transports could be differentiated, whether the primary origin in the processing and transportation chain of the goods is within the Alps or outside, as well as whether the final destination in the processing and transportation chain of the goods is within the Alps or outside. However, the latter might raise more difficulties.
- By location of the traffic flows,
 - internal transports (origin and destination in the Alp region),
 - incoming/inbound transports (origin outside, destination inside the Alp region),
 - outgoing/outbound transports (origin inside, destination outside the Alp region), and
 - transit flows (origin and destination outside the Alp region) are distinguished.
- Moreover, “border-crossing” (naming the demarcation line of the Alp region a border) transports can be taken into account regarding their full distance or only the internal fraction of the respective flow.
- Another relevant differentiation refers to the modes of transportation.
 - Whereas the ground-based modes (by feet, bicycle, car, and rail for persons, and by truck and rail for freight) always will be of interest
 - It might also be of some interest to include the transiting air transport (overflight of the Alp region) as well as bypassing water transports (circumnavigating the Alp region) for the generation of meaningful comparisons.
 - Beyond that, also modes may find some interest, which commonly are not considered, like pipelines, electric transmission lines, or the several forms of lifts and cableways.
- In terms of concern and relevance, the territorial principle may be held appropriate, i.e. to address the transport flows on (and above) the territory of the Alp region.
- In terms of responsibility and greenhouse assessment, a different attribution seems adequate. As a fair way of accounting, internal transport flows could be included in

total whereas border-crossing flows could be included half-distance, having in mind that there are respective interests on both ends of the flows. For passenger transports, simply one direction could be regarded, due to the predominant symmetry of the flows. The transit flows, on the other hand, might get fully allocated to external causers. However, as they are passing the alpine region, they might – at least theoretically – be influenced by transport policy in the region. Due to this fact there could be arguments to include them as well.

- Climate Neutral Alpine Transport would therefore mean: Both the transport flows within the Alps and flows with origin or target in the Alps are done without burning fossil fuels (in the vehicles or in power plants, respectively). If secondary energy carriers like electricity, hydrogen, or even fuel for ordinary combustion engines are used, their footprint has to be climate neutral. There is an overlap with the energy sector here.
- A mere exemplarily approach could also look at transit flows specifically.
- Overlaps exist with other sectors as well, especially tourism. For the GHG footprint of products and services the energy demand resulting of commercial transport demand has to be taken into account.

3.3.2 Targets

- In general, transport does not appear to be the first sector to fulfil climate-neutrality targets, not outside and not inside the Alp region. However, a good overall result is not very likely if the transport sector does not contribute largely by reducing its climate burden. It should find special attention, what emission reduction is held accessible in the transport sector and what possible compensation could be provided by other sectors to balance a more critical reduction through transport alone.
- Technical concepts toward low emission individual transport are still further to be developed, but always have to be combined with measures optimising modal shift and transport volume.
- Generally it has to be said, that climate neutrality would mean to rethink the role of transport in the Alpine society and economy with the long term target of decoupling welfare and growth from transport growth and to reduce the latter from the currently high level.

3.3.3 Implementation

The elaboration of a fairly sound picture of the real situation and the driving forces determining the future development of transport and the transport-related burdens are a precondition to define quantitative targets. This might be done by

- Linking a well-educated scientific approach to official support and a lot of local knowledge in a multi-national and multi-lingual – at some extent also a multi-cultural – context.

- It may be crucial here to implement some understanding that the transport of tourists back and forth the Alpine target regions has to be taken into account as well, when claiming CO₂ neutrality of the region.

A systematic approach together with the establishment and strengthening of the connection to spatial planning to avoid interlinked undesirable developments might be necessary for the evaluation of good-practice examples and the search for additional helpful instruments and actions. Such an approach could follow a hierarchical order:

- Factors/circumstances involved in the generation/induction of transport
 - such as the patterns of settlement and their equipment with facilities, or the convenience, cost, and speed of the available transport options.
- Factors/circumstances influencing the modal choice of transportation means
 - such as the supply with public transport (spatial coverage, frequency, speed, tariffs, integrated fixed cycle operation, comfort), or the availability of car and bike rentals.
- Factors/circumstances influencing the shape and characteristics of the used vehicles
 - such as bonus-programmes for low-emission models or retrofitting vehicles in use, or particular exclusions of vehicles missing specific standards.
- Factors/circumstances influencing the respective operating mode of the vehicles and, in general, the actual flow of traffic
 - such as speed limits, priority signalling for public transport or training of the vehicle drivers.

Different to many other regions, parts of the traffic in the region examined here can be addressed directly, since travelling through the Alps for many visitors has an end in itself. Anyway, most of the transport is functional, and therefore to be addressed together with the function supported by the respective transports. Hence the overlaps with the respective other clusters are to be regarded.

This is most obvious for tourism, which plays a major economic role for large parts of the Alp region; therefore sustainable touristic transport is a crucial requirement, though not the only one, for a sustainable tourism.

The regional industrial structure, naturally, is essential for the freight transport; hence the weight of local or regional economic and material flows can be addressed as an important subject.

For the people living in the Alp region and their transport, the spatial patterns of settlements and activities is decisive; spatial planning and its regulatory backbone therefore will be very important on the long run.

In all these cases the combination of specific functions with transport should be addressed. Taking the variety of historical experiences, of national traditions and cultures in the Alp region into account, any part of the region should be able to benefit greatly by learning lessons from other parts of the region.

The future spatial structures of human settlement in the Alps may turn out a key factor for sustainable transport. Historically, the band-shaped structures along the valleys facilitate the

provision of public transport services. Mitigating the more recent sprawl could regenerate this opportunities.

Beyond that, there is a broad range of individual measures which have to be chosen in the respective cases. This include in particular:

- Reducing housing locations outside the continuous built up areas
- limitation or reduction of part-time residents
- favouring tourists staying for a longer period of time versus one-day visitors
- the re-dimensioning of the roadwork: reduction of the extension, weakening the level of service and limited capacity
- specific vehicle concepts meeting particular needs of the region (especially: low speed, but high climbing capability)
- social networking based on modern communication technologies to reduce transport demands and to optimise transport flows
- internet-based delivery concepts to supply remote farm houses in an efficient way
- rising costs for transalpine transports

4 Main economic fields

4.1 Land use, agriculture and forestry

4.1.1 Scope and boundaries

- The main overlaps of the cluster with neighbouring clusters are with tourism, transport and energy. Further, the cluster shows particular links to the adaptation to climate change.
- Three main aspects are in the focus.
 - At first, GHG emissions from different types of land use resulting from the reduction of their sink function of the natural soils and vegetation. Several types of land use are addressed in other clusters (e.g. tourism, settlements, transport, energy, ...) the cluster therefore focuses on land use for agricultural and forestry purpose.
 - Second, GHG emissions from agriculture itself (apart from the use of land) are taken into account. Energy use, cattle and manure, fertilizers etc. are possible sources for GHG emissions. Further, agriculture can become a producer of renewable energies.
 - Third, taking into account the sink-function of soils. Vegetation and water bodies, land use and agriculture exclusively have the possibility to generate net-negative GHG emissions.
- The cluster can thus be defined as covering alpine pastures and meadows, forest, permanent cultures and arable land as the main fields of non-settled land use and agriculture in the Alps.
- Currently available data needs to be harmonized between the alpine states. While rough estimates on the emissions from agriculture seem to be possible, data on the sink function is still quite limited.

4.1.2 Targets

- General principles for a target setting would be for the sector:
 - The reduction of CO₂ and other GHG emissions.
 - The extension and creation of carbon sinks.
 - The protection of existing natural carbon storages.
 - The prevention of sudden carbon releases (forest fires).
 - Within this context a decision concerning the hierarchy of different targets for land use and nature protection (CO₂-reduction, biodiversity, nature conservation, agriculture, tourism, ...) has to be made.
- Looking at the chances the cluster offers regarding carbon sinks and storages it becomes apparent, that an overall GHG emission target of zero GHG emissions may

not ambitious enough for this cluster. It could be even targeted to reach net negative emissions in land use.

- Another target is to protect arable land and natural resources against overly intensive human utilization, which leads to soil erosion and degeneration. Furthermore the protection against the influence of a changing climate is an important target within this cluster.
- Finally a restructuring of the existing agricultural production and new concepts of sustainable land use in the context of a changing climate are to be targeted.

4.1.3 Implementation

A very important level of decision-making in the agricultural context is the European Union. On the other hand a successful implementation needs to involve stakeholders from the regional and local level. Their knowledge on site-specific conditions is important to judge the practicability of the measures and strategies. Therefore enabling and initiating a stakeholder dialog is considered to be a potentially important element of the main study.

There are several institutions in the alpine region, dealing with the protection of alpine eco systems. It has to be verified whether the development and monitoring of the described strategy could be a task for these institutions.

Potential focal issues of a future strategy towards more sustainable land use and agriculture⁸:

- Increase production of soil organic matters, withdrawing CO₂ from the atmosphere
- soil- and water-protecting crop production (conservative cultivation strategies, no-till farming, erosion protection, mechanical weed control)
- Abandonment of chemical nitrogen and synthetic fertilizers, use of natural fertilizers (manure and compost); On-farm or cooperative use of manure between crop and livestock operations
- Reduction of livestock density
- Automation and data network (site specific cultivation strategies, fleet management)
- Electric or bio-fuelled engines and machines
- Improvement of energy efficiency and renewable energies (combination or abandonment of work stages, resource protecting biomass production, improvement of conservation technologies)
- A labelling system that could guarantee climate neutral agricultural products
- Subsidies for farmers to improve the production of renewable energy sources and to extend or protect existing sinks and storages (like in case of pasture cultivation)

⁸ C. de Jong (2009) : Climate neutral land use and nutrition. Presentation on at the expert hearing, 02.09.2009 Munich.; Muller, A.; Davis, J.S. (2009): Reducing Global Warming. The Potential of Organic Agriculture. Policy Brief 31.05.2009; The following list gives a first indication. However, setting up a complete list has to be a task for the main study.

All these measures have to be brought together in a strategy to protect soils against harmful and destructive anthropogenic and climate related impacts, reduce emissions from agricultural processes and to extend, create and protect natural carbon sinks and storages.

4.2 Tourism industry

4.2.1 Scope and boundaries

- The tourism sector intersects with other sectors analyzed in this project such as buildings and transport as well as energy and can be considered as a cross-cutting cluster.
- Given the high interaction of the sector with regions outside the Alps, instead of pursuing a territorial approach, it might be worthwhile identifying fields of action.
- There are four main fields of action in which greenhouse gas emitting activities take place.
 - The first and most relevant one is the area of transportation. A general distinction could be made here between the journey to and from the resort as well as local climate impacts of tourism during the stay. There could be put a particular emphasis on the impact of different means of transportation on greenhouse gas emission. Although the main portion of this aspect takes place outside the Alpine region it has to be considered in this cluster as well.
 - The second field of action is accommodation where the tourism cluster intersects with the cluster of housing and construction. Passive house standards and careful use of energy and water might reduce the emitting activities of tourists.
 - Food and the food supply chain represent a third field of action in the tourism cluster. Overlapping with the land use and agriculture cluster, the emitting impacts of providing hotels and apartments with agricultural products from other regions or countries are often underestimated.
 - The transportation cluster is again addressed when it comes to mobility and activities on site which stands for the forth field of action. It might be considered to differentiate between ski tourism and other reasons for visiting (such as city tourism or hiking tourism) because they require different kinds of infrastructure. Due to many intersections with other clusters it is important that emissions are not double counted in different clusters.
- Strict reduction and the possibility of offsetting of GHG emissions are the two main ways to reach climate neutrality. In a wide definition also the provision of climate neutral tourism products as a replacement for other more harming product of other regions might contribute to overall climate neutrality.

4.2.2 Targets

- Considering the fact that the Alpine region is already being affected by climate change, politicians, scientists, tourists and the local population should not hesitate to discuss the ambitious target of 100% climate neutral tourism by 2050 seriously.
- The following examples in different fields of action are a first attempt how the Alpine region could become a forerunner in the segment of zero emission tourism:
 - Transportation: a strong shift to climate friendly modes of transportation including journeys to and from the resort (e.g. by train and busses), affordable and flexible public transportation at site
 - Accommodation: passive houses and use of (local) renewable energy
 - Food: regional supply, sustainable agriculture
 - Activities: renewable energy based ski infrastructure (ski lifts, snow making)

4.2.3 Implementation

- A combination of multiple adaptation and mitigation strategies should be considered. Emphasis should be also put on awareness raising for tourists and local population. Another strategy could be to introduce tradable individual carbon quotas for tourists.
- Most of the technical innovations and developments do not take place in the tourism cluster. However, the support of such technical solutions from other overlapping clusters (e.g. energy or housing and construction cluster) can help to reach climate neutrality in the cluster of tourism. Tourism industry could become a driver for those developments in other clusters by creating a strong demand and providing the necessary purchase power for pioneer activities.
- Another strategy to facilitate the implementation of zero emission tourism could be the scaling-up of good practice examples from a local to a regional level. Actors should consider which of the already existing or future good practice examples have potential for a broader implementation.
- A change of trend also in tourism is necessary that aims at affordable “soft” mobility and a regional closed loop supply management with local products and energy carriers. In transport planning, tourism has to be duly considered, just as in planning of holiday areas tourism-related transport has to be included. For that purpose, especially political decision makers at all levels and in international co-operation are in demand.
- Political decision-makers at all levels have to recognize motor-driven individual transport as well as air traffic for tourism and leisure time to be a specific problem with regard to climate neutrality. Targeted promotion of eco-mobile transport modes as well as expansion of public transport are to be supported in terms of low carbon mobility for everybody. Awareness of travellers and guests how they can contribute to climate protection in the holiday destinations has to be increased. Regional supply with goods, energy and water can help save and avoid transport costs. All

stakeholders are in demand to build up and promote a regional supply in tourism, if possible through local Agendas 21, and an integrated regional planning.

- New management models for climate friendly tourism should be developed. One case in point is the research project “Sustainable Tourism in Alpine Regions: Management and Monitoring” at the University Sankt Gallen⁹ in Switzerland that looks into tools for regions to act on their own initiatives.
- A change of trend in terms of ecological and socially adequate travelling modes is possible, if tourism is integrated into regional development that is geared to environmental and social aspects. Tourism planners are requested to secure a feedback of tourism with environmentally friendly regional agriculture and energy- as well as water supply and waste management. Through appropriate political measures, private investors and tourism companies should be incentivised to use regional markets.
- For tourism to be integrated into sustainable regional development it should be included into in local Agenda 21 processes. The tourism industry and decision makers from the local to the national levels are requested to initiate and make financially viable a stakeholder process.
- In fragile mountainous areas, land and soils must be protected from the installation of a ruinous touristic infrastructure.

4.3 Other industries, services and commerce

4.3.1 Scope and boundaries

- There are overlaps with the energy cluster as industrial processes include emissions caused by energy generation. Furthermore, industry and commerce intersect with transport as land and air transport are part of commercial activities as well as they are triggered by economic activities. The cluster is also interlinked to buildings where industrial and commercial activities usually take place. There also exist overlaps with the clusters tourism and agriculture, too. These are considered important parts of the cluster industry and commerce, but due to their high economic importance for the Alpine Region they are treated separately.
- The cluster thus consists of manufacturing, industry, handcraft, power industry and energy and water supply, plus the tertiary sector. However, energy production as tourism and agriculture branches given their high relevance for the economy and the GHG emissions have been assigned special clusters in the context of the study.
- It is not sufficient to consider information on the aggregated industry level. Rather the economic branches of single sectors need to be analyzed in detail. As countries do not record statistics for the alpine region it is therefore suggested to leave the country

⁹ http://www.nfp48.ch/projekte/projects_detail.php?nfprojnum=28.

approach aside and to take the Alpine region as a whole in order to identify relevant industrial and commercial activities.

- The energy input level can be seen as an indication for the level of GHG emissions generated during the production period. Combining high economic with high greenhouse gas relevance allows to identify so called „hot spots“ and fields of actions.
- These investigations should go beyond the territorial approach. Not only direct emissions, but also grey emissions related to foreign trade, i.e. to the import and export of goods and services, should be included.

4.3.2 Targets

There are several starting points to approach the target setting in the industry and commerce cluster. Possible targets for a carbon neutral industry and commerce cluster could refer to:

- Only reduction of territorial GHG emissions
- But also to product, service and process based emissions and of international supply chains
- A general dematerialization, i.e. the reduction of material use in industrial production processes.
- An actor-/sector-/ or branch-based perspective offers the following modes of target setting:
 - Enterprises or branches themselves set targets
 - Consumers have a certain carbon budget at their disposal.
- A quantitative approach could for example set the target of 100 % climate neutrality. It will be the task of the main study to further substantiate if and how it is possible to achieve. To this end, the main study will need to analyse fundamental changes in economic models and in consumption patterns.

Furthermore, it is impertinent to implement top efficiency including cradle to cradle and to maximize renewable resources. The 100 %-target for a climate neutral industry and commerce cluster could be broken down to for example 100 % renewable electricity/ 100 % renewable energy supply, 100 % CO₂ carbon capture and storage in energy intensive branches that have fully exploited their technical savings potentials, compulsory combined heat and power to enable the usage of excess process heat in the industry sector, and the relocation / reduction of sectors with low value added or employment effects.

4.3.3 Implementation

At the moment government and politics run most activities especially on national level. However, climate neutrality did not play a role so far. Rather it is attempted to break down international climate goals to the sectors. At the local level punctual activities exist but not with clearly definable stakeholders but many individuals. In view of the individual branches

no relevant player could be identified. A precise and sectoral analysis – including the corresponding organizations and interest groups – is needed.

Most activities are at the national and federal level. Some regulative policies (CO₂-charges in Switzerland) exist but most concepts are voluntary. They usually aim at motivating businesses and the industry to carry out climate protection. Systematic strategies with ambitious reduction goals could not be observed.

With respect to small and medium sized companies CCS or compensation schemes are not suitable due to their small production sites. For these companies more specific, micro-economic instruments are necessary, for example:

- Regional autarkic energy production from renewable energy sources is already existent in some towns in Switzerland. Such examples could be spread over the whole Alps.
- Systematic improvement of energy efficiency of production sites, in particular buildings via consistent insulation, energetic reconstruction etc.
- Strategies for strengthening local economic cycles. If resources, materials, pre-products etc. are purchased on the local market, emissions from both less transport and less material flows can be avoided.
- Another strategy is the further spread and higher acceptance of environmental management approaches in small businesses. By implementing environmental management systems it is easier to improve energy efficiency as well as resource efficiency continuously within the production process.

The analysis of actual emission data outlines the following. A few branches within the industry cluster are in large part responsible for the industrial emissions. The energy intensive branches machine production, generation of electricity, chemistry and wood processing in particular. Therefore, the development of policy-strategies should focus on these branches. This means that individual goals should be established by considering sectoral usage and technical reduction potentials.

Moreover, policy instruments should address the central Hot-Spots. These are:

- emission intensive branches with a high value added
- branches with particularly low value added but still high emission

The differences in economic relevance should affect the choice and evolvement of policy instruments.

5 Spatial planning and institutions as enabling factors

As well as in the other clusters climate neutrality is the target set in the spatial planning cluster. The attainment could exemplary be based on the following measures:

- Institutional innovations towards local renewable energy autonomy, integrating sun, water, bioenergy, wind and geothermal resources
- Short-horizon phasing out of increasingly destructive development practice
- A turn from high consumption levels (of water, land and materials) along with an equally important shift in land use patterns are as crucial as deliberate moves to re-localise economies and relations
- Land use changes geared towards carbon and nitrogen management
- Regionally specific finance and investment strategies aimed at carbon-free content in products, energy, services, infrastructure and property

Numerous best practice examples (low energy buildings, compact settlement structures, Biosphärenpark Großes Walsertal, ...) could function as starting points for the implementation of climate neutrality in spatial planning. The underlying principle or mechanism has to be to convert best practice as a (minimum) standard in spatial planning.

6 Institutions

6.1 Scope and boundaries

- In the context of this study the institutional dimension only refers to what can be equated with the term „organisations“.
- We look at institutions that reflect the politically established Alpine Convention from the side of the civil society. In this context non-governmental organisations include all kinds of institutions that do not belong to the government, which means that economic confederations are considered as well as social and environmental associations and networks.
- Institutions play a role in all of the other clusters because a lot of organisations highlight and support different aspects of the other sectors by organising conferences, publishing books and newspaper articles or giving interviews.

6.2 Targets and Implementation

- Institutions in form of networks, alliances or competitions play a significant role in spreading the concept of climate neutrality. Individual stakeholders can be reached and mobilised much faster and in a more cost effective way by addressing their subordinated associations.
- Participation in institutions that promote climate neutrality might create a competitive advantage and a positive image for the member as well. The general population becomes more and more aware of the problem of climate change and is willing to invest resources in sustainable and eco-friendly goods and services. This is the point where members can profit from quality certifications and a good reputation of an institution.
- Various visionary concepts are first developed and implemented by institutions and their networks. Later on, best practice examples can be made public by organisations. They might attract attention of other actors who are considering to adopt the concept. This helps to spread these punctual examples on a broader spatial dimension.