ORGANIZZAZIONE INTERNAZIONALE TRASPORTI A FUNE
INTERNATIONALE ORGANISATION FÜR DAS SEILBAHNWESEN
ORGANISATION INTERNATIONALE DES TRANSPORTS A CABLES
INTERNATIONAL ORGANIZATION FOR TRANSPORTATION BY ROPE
ORGANISACION INTERNATIONAL DES TRANSPORTES POR CABLE

Technical recommendations in effect

BOOK 23-1
(Edition 2018)

ON ENVIRONMENTAL PROTECTION IN THE ROPEWAY

INDUSTRY

ROMA 1957
PARIS 1963
LUZERN 1969
WIEN 1975
MÜNCHEN 1981
GRENOBLE 1987
BARCELONA 1993
SAN FRANCISCO 1999
INNSBRUCK 2005
RIO DE JANEIRO 2011
BOLZANO – BOZEN 2017

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ORGANISACION INTERNATIONAL DES TRANSPORTES POR CABLE

Sede : I-00144 ROMA – Viale Pasteur, 10

O I T A F

OITAF - RECOMMENDATION

Book 23-1

Edition 2018

ON ENVIRONMENTAL PROTECTION IN THE ROPEWAY INDUSTRY

Documents and guidance for good practice with regard to

- **Collision of birds with glass panes and wire ropes**
- **Ski slope construction and operation**
- **Snowmaking and monitoring — water management and hydrological foundations**
- **CO2 and energy savings**
- **Energy efficiency in ropeway companies**

FOREWORD TO THE RECOMMENDATIONS

In regular meetings, OITAF's Work Committee VII “Environment” addresses environmental issues in the ropeway industry and presents them as recommendatory "guidance for good practice".

Objective of the recommendations

The objective of these papers is to discuss environmental issues that already have to be considered during project design. As a result, subsequent administrative procedures can be implemented efficiently and speedily.

In recent years, Work Committee VII “Environment” worked on the following subjects:

Finalized papers:

- **Collision of birds with glass panes and wire ropes**
- **Snowmaking and monitoring — water management and hydrological foundations**
- **CO_2 and energy savings**
- **Ski slope construction and operation**
- **Energy efficiency in ropeway companies**

Subjects under discussion

- Avalanche protection measures
- Climate in general — impact on the ropeway industry
- Efficient use of water resources
- Environmental management
- Environmental liability and environmental protection in general
- Consideration of the Habitats Directive and the Birds Directive

The guidance on the subjects listed above is to help all parties involved both in the design phase and in the operational phase.

Please note that the extent to which these papers are to be used has to be individually assessed for each project and each company. Utmost attention has to be given to special regional and local aspects (legal regulations, natural characteristics of specific sites).

Work Committee VII currently has 18 members from 6 countries (6 AT, 2 CH, 2 DE, 2 ES, 2 FR, 4 IT) including representatives of supervisory authorities (2), operators and manufacturers (7), universities (1), professional organizations (2) and planners (4). The following Works took part in the – sometimes very detailed – discussions on the numerous subjects (listed alphabetically by country):

Germany: Augustin Kröll, Birgit Priesnitz

France: Gerhard Lohrentz, Julien Noel

Italy: Andreas Dorfmann, Werner Noggler, Paul Profanter, Mark Winkler,

Austria: Günther Aigner, Michael Manhart, Ulrike Pröbstl, Gunther Suette, Kurt Ramskogler, Peter Winkler,

Switzerland: Alexander Stüssi, Nicolas Vauclair,

Spain: Joaquin Alsina Gil, Aureli Bisbe I Luch,

National ropeway organizations are recommended to communicate this "guidance for good practice" to their member companies and discuss them in relevant committees.

OITAF Work Committee VII

International Organization for Transportation by Rope

Collision of birds with glass panes and wire ropes

Guidance for Good Practice

The present paper is to help all parties involved both in the design phase and in the operational phase of ropeways and buildings with glass façades.

Please note that the extent to which this paper is to be used has to be individually assessed for each project and each company with utmost attention having to be given to special regional and local aspects.

In the mountains, birdlife is affected by manifold technical artifacts in the landscape. These include material ropeways, barbed wire fences and electric fences used in agriculture and fences to prevent browsing, control fences and mobile cable cranes used in forestry. Other relevant installations are transmission facilities, towers and overhead lines in the field of telecommunications and ropes and avalanche blasting systems as well as buildings and glass panels related to ropeways.

1. Ropes

In particular, thin signal cables are recognized to pose a serious problem in grouse habitats in view of the resulting injuries to birds. Ropeway operators have the task to find solutions. This mainly applies to older installations as most signal cables are buried today.

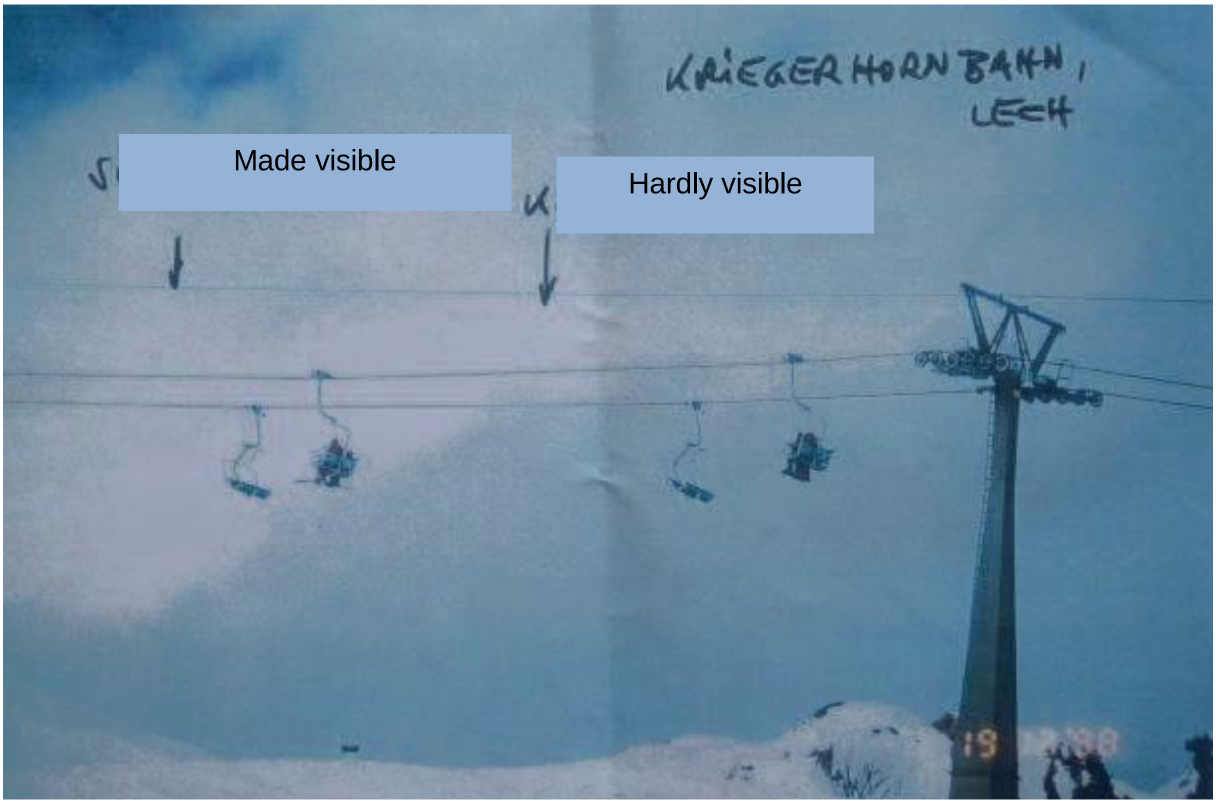
Long-term observations (D, F, A, CH) showed that approx. ¾ of accidents involving birds were caused by overhead signal cables. After these cables were marked – either by means of red bands or movable red balls – not a single injured or dead bird was found in France anymore.
This method can only be used for stationary ropes but not for moving ropes.

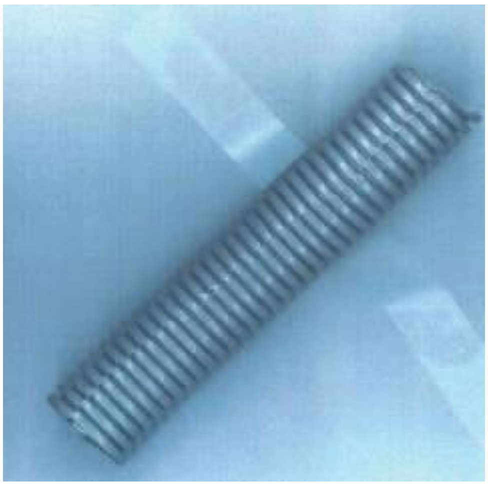
Upon the modernization of many installations and the construction of new chairlifts with track ropes thicker than 30 mm and buried signal cables a considerable reduction of bird accidents was found in comparison with old surface lifts with thin carrying-hauling ropes and signal cables suspended above them.

For older installations with overhead signal cables, it is recommended to color the cables blue or provide them with a blue cover in order to improve visibility (the system applied in Lech uses a slit plastic tube, no risk of icing) as this color seems to be well visible for birds.

Please note that birds see "red" as "black", whereas "blue" is a loud color for birds (nevertheless, the results recorded in France are also in favor of "red").

For special types of ropeways, such as zip-lines, a blue rope should run in parallel to the main cable (either to its left or right).
Skilifte Lech carried out trials on how to improve the visibility of thin cables. At the Kriegerhorn triple chairlift, the control cable was covered by flexible electrical installation conduits made of hard PVC which greatly improved the visibility of the thin cables and hence reduced the collision risk.





For stationary ropes, so-called "hangers" also seem to be suitable for enhancing visibility (current examples are spans of high-voltage lines across rivers and highways).

Experience showed that higher track widths of ropeways reduce collision risks because birds tend to fly along the line.

2. Glass facades and glass panes

General experience shows that apart from the problems resulting from thin ropes, glass façades are another serious issue for bird accidents.

In general, the following risk scenarios can be identified:

- Collision risk resulting from non-recognized obstacles (full transparency)
- Collision risk resulting from the reflection of natural surroundings
- Collision risk resulting from birds searching for escape routes and flying for cover
- Collision risk resulting from fog and differences in brightness

With regard to buildings with glass and reflecting surfaces, bird protection already has to be considered during the planning phase.

Recommended solutions are, for example, patterns applied to the exterior surface and inclined or tinted glass panes that are not fully transparent and do not show reflections with or without coloration (see also Glassolutions, ECKELT, 1998).

Marking glass with predators does not show a satisfactory effect. Another solution, especially for large windows, is integrated strips or dot patterns whose density increases from the bottom up. In particular, glass with dot patterns yields the best results according to tests of the *Swiss Ornithological Institute* (tests with 40 to 50 different glasses). (https://www.vogelwarte.ch/en/projects/conflicts/birds-and-glass)

Another option is to install adjustable exterior blinds on glass fronts, but their disadvantage is that they are not windproof.

Fixed exterior blinds in an appropriate color, e.g. middle blue, with a broad beam structure (horizontally 20 cm wide with 10 cm spacing) or painted throughout are very well suited for preventig collision of birds with window panes.

The collision risk is highest at the start and end of the day, especially under foggy conditions. Most bird species are most active in the morning while, for example, the activity of black grouse peaks in the morning and in the evening.

OITAF Work Committee VII

International Organization for Transportation by Rope

Snowmaking and monitoring — water management and hydrological foundations

Guidance for Good Practice

The present paper is to support all parties involved both in the design phase and in the operational phase. It is to help identify relevant issues of snowmaking that already have to be considered during project design so that subsequent administrative procedures can be implemented efficiently and speedily.

Please note that the extent to which this paper is to be used has to be individually assessed for each project and each company with utmost attention having to be given to special regional and local aspects.

There is no doubt that the installation and operation of snowmaking systems constitutes an intervention into the natural environment. In particular, the withdrawal of the water they consume plays a significant role. Moreover, it has to be borne in mind that the water spread as technical snow can also have impacts on the terrain next to the ski slopes as well as on receiving bodies of water in the thawing season. In addition to water (before, during and after its application as technical snow), the climatic situation prevailing in the ski resort in question is of major importance.

Apart from careful preparation in the planning phase, it is also necessary to comprehensively monitor climatic, hydrological and hygienic (bacteriological) parameters in order to allow for optimizing interventions during operations.

To clarify the meaning of "monitoring", a concise definition of this term is provided:

Monitoring is a generic term covering all types of direct systematic recording, observation or surveillance of an event or process by means of technical resources or other observation systems.

Water management requirements

Taking into consideration the legal framework, in particular the EU Water Framework Directive, and the natural characteristics, the installation and operation of a snowmaking system must not adversely affect or disturb the water regime and the related natural hydrological cycle to an unacceptable extent. This means:

- Water needs to be available in sufficient quantities and appropriate quality in order to allow for the proper operation of the system while maintaining the good status of the relevant water bodies.

- In the case of water withdrawals, appropriate checks have to be performed of hydrological, hydrogeological and ecological conditions and the results of the checks have to be input into the projects.
- Surface waters used, affected or located in the vicinity of ski slopes and snowmaking installations have to be protected by appropriate planning in such a way that their good ecological status is maintained.
- For all measures taken (structures installed) on water bodies, the necessary capacity of the water body to drain floodwater has to be taken into account.
- The design of the water withdrawal structures has to be adjusted to the guaranteed mandatory residual volume of water.
- The place of water withdrawal has to be designed in such a way that it can be passed by aquatic organisms.

Preparatory work

During the planning of snowmaking systems, the hydrological and climatic conditions, such as the availability of the required water quantities over time as well as the local climatic conditions, have to be studied. For this task, the long-term observations of hydrographic and meteorological agencies constitute an excellent source of data, which have to be complemented by local measurements relevant for the project.

This intensive preparatory work is of utmost importance not only with a view to one's own responsibility but also with regard to the EU Water Framework Directive as this is the only way to meet the requirement that the status of water bodies must not deteriorate and to achieve the objective of a "good status".

To ensure that the monitoring network is efficient and cost-effective, own measurement sites may have to be planned in individual cases with regard to their location and the parameters to be recorded in line with the special conditions in a ski resort to supplement the monitoring sites of public agencies.

Basis of monitoring

In many fields of industry and science, the continuous monitoring of processes, operations and natural phenomena forms part of key activities. This monitoring serves for:

- obtaining data and knowledge,
- verifying hypotheses, and
- better understanding phenomena.

In the specific case of snowmaking systems, monitoring activities are primarily performed in the narrower field of **hydrology** (hydrology is the scientific study of water, its spatial and temporal distribution in the Earth's atmosphere, on and below the Earth's surface as well as the related biological, chemical and physical properties and effects of water).

The main working areas of hydrology are the observation and measurement of hydrological processes within the water cycle (precipitation — air temperature — evaporation, surface water, groundwater and spring water) and the systematic analysis of hydrological phenomena.

In addition to general hydrology, there is the field of hydrometry that deals with the quantitative aspects of the hydrological cycle. It collects, analyzes and presents data about surface waters, groundwater and precipitation.

Monitoring — why?

The continuous observation of air temperature, (atmospheric) humidity, water level and discharge (for surface waters and groundwater including sources) permits the assessment of long-term conditions and their change as well as the likelihood of available water resources and optimum times for snowmaking.

Professional monitoring that provides a record of previous processes can be used to identify forward-looking scenarios on a statistical-analytical basis and meet requirements of water management, water regulations and business management during their implementation.

Moreover, it can provide initial answers to the following issues:

- Snowmaking only works under specific climatic conditions and in order to obtain good results, the long-term behavior of climatological phenomena is of special importance (climatology).
- Water may only be used in such a way that the status of the water body from which water is withdrawn does not deteriorate permanently (under the terms of the EU Water Framework Directive and water legislation); related evidence has to be gathered by taking appropriate measures in qualitative and quantitative terms (water management).
- Legal restrictions on the utilization of and impacts on water and bodies of water and for the protection of resources and third-party rights have to be taken into consideration; a body of water may only be used to an extent that does not result in its sustained impairment (water legislation).
- Only when climatic conditions are optimally used it is possible to achieve good results; the costs of snowmaking also have to be monitored (business management).

To follow the guidance and recommendations outlined above, data have to be collected for several parameters:

Climatology	**Hydrology**	**Hygiene, bacteriology**
Air temperature Humidity Wind speed Wind direction Precipitation	Flow rate Groundwater level Spring discharge Quality parameters	Chemical-physical parameters Bacteriological parameters

Those parameters have to be recorded at an appropriate temporal resolution. This is necessary because such data are the only basis for obtaining statistical likelihoods for the occurrence of certain phenomena with a high level of confidence and for developing forecasts and identifying the scale of phenomena.

Within the framework of project development, the required parameters, the number and location of monitoring sites as well as data transfer from monitoring sites to the operations center should be defined. It is recommended that measurements and observations start as early as possible in order to permit the analysis of the data collected with regard to both the implementation of snowmaking operations (business management) and compliance with legal requirements (impact on or infringement of third-party rights).

Collection of data relevant for snowmaking systems

The collection of data relevant for snowmaking systems should cover the fields of precipitation and air temperature, surface waters and solids as well as underground water and springs.

As it is safe to assume that the informative value of data will increase along with the duration of data collection, it seems to be expedient to rely not exclusively on data gathered within ones own network of monitoring sites, but to use also long-term data series available from public agencies, e.g. national and international meteorological services as well as regional and national hydrographic services.

In contrast to data collected by ropeway operators that are of local significance, the above data provide information on larger areas and quickly permit simplified forecasts.

In all fields, data should be collected continuously both in temporal and spatial distribution in order to reach an appropriate informative value.

With regard to data analysis, it has to be borne in mind that except for weather radar data, all the data are related to specific points whose informative value decreases as the distance to the measurement site increases.

Precipitation may be recorded and/or supplied by agencies as event data, daily, monthly and annual values as well as extreme values. In addition to those data, measurements of air temperature that are generally offered as 7h, 14h and 21h values are also of interest for the optimized operation of snowmaking systems.

The statistical analysis of these data together with the data locally recorded by ropeway operators is of utmost importance, especially with regard to the frequency of events and the likelihood of their occurrence.

Another tool that becomes more important for snowmaking is meteorological forecasting. Forecasts are extremely helpful for fixing dates for snowmaking because the staffing and technical prerequisites can be ensured in the run-up to favorable climatic conditions so that efficient actions can be taken upon the occurrence of the phenomena that are suitable for snowmaking. This information can be obtained from the relevant meteorological agencies. This relates both to the forecasting models used and to the accessibility of forecasting results.

Water quality

In addition to the hydrological-climatological domains mentioned above, the monitoring of the quality of the water sources used will become increasingly important in future. Again, it is possible to use also data of public measurement sites.

Data management — data transfer

In general, there are several options for transmitting data. They range from conventional transfers via the fixed telephony network and GSM, GPRS and satellite transmission to radio transmission.

OITAF Work Committee VII

International Organization for Transportation by Rope

Ski slope construction and operation

Guidance for Good Practice

The present paper is to support all parties involved both in the design phase and in the operational phase. It is to help identify issues relevant for the construction and operation of ski slopes that already have to be considered during project design so that subsequent administrative procedures can be implemented efficiently and speedily and ski slopes can be operated ecologically thereafter.

Apart from good snow conditions, a successful skiing season requires above all ski slopes that are optimized with regard to technical standards, the safety of slope users and environmental impacts.

This applies not only to existing ski slopes but also to new ones and extensions.

Please note that the extent to which this paper is to be used has to be individually assessed for each project and each company with utmost attention having to be given to special regional and local aspects.

It is an undisputed fact that ski tourism constitutes an intervention into the environment, but the practicing of winter sports as a leisure activity has significant social, societal and economic aspects.

Therefore, the aim is to provide well-groomed and safe ski slopes for winter sports especially in areas that already have the required infrastructure. In this context it has to be ensured that adverse ecological impacts and environmental degradation is avoided or minimized as far as possible as a result of the slopes as well as their maintenance and management.

Legal, water management, technical and ecological aspects are of top priority during planning, construction as well as operation.

In 1990, the Environmental Forum of the Austrian Cableway Association defined the following objective that also applies to many other mountain regions:

"Our environment is the Alps, a cultivated landscape rich with nature. In the course of many centuries they have become what makes them valuable and loveable today.
All our efforts focus on people — on residents and guests alike. The Alps are the home where the former live and work and an area of recreation for the latter.
The demands and requirements for this area of living and recreation are high and can only be satisfied by a sustainable economy that meets ecological requirements.
Tourism and agriculture shape the cultivated Alpine landscape extensively.

Therefore, tourism and agriculture need to collaborate in sharing benefits and responsibilities. Both sectors play a decisive and vital role in maintaining and further developing the Alpine region, specifically: Cultural activity in agriculture serves for preserving ecological stability, natural diversity, scenic beauty and the core of the residents' identity through the ages. The utilization and provision of access to the landscape, all necessary interventions and maintenance measures have to focus on the overarching and uncontested goal of conserving the value of the Alpine landscape. The ropeway industry is fully aware of all those tasks."

This objective implies that all measures and steps taken have to be orientated to compatibility with land use and landscape protection. The following aspects have to be given consideration:

- character of the landscape
- appearance of the landscape
- stability of the landscape
- natural characteristics

To sufficiently meet the demands, the set-up, optimization, maintenance and recultivation of ski slopes has to be carried out in line with the requirements.

The specific goals of all measures are:

- the stabilization of ski slopes, including their revegetation in line with local conditions
- the optimization of nutrient and water flows, including the safe discharge of slope runoff
- continuous slope maintenance

In this context, please also see the paper on ski slope maintenance.

Ski slopes can impact the existing situation of precipitation runoff in many ways. These impacts have to be assessed not only for the location itself but also for the larger area. The criteria to be used for assessments are to focus on the minimization of adverse effects on land and structures in the vicinity of the ski slopes, also with regard to frequent events, and on the prevention of an aggravation of flood risks in the wider runoff regime.

Water

Thy hydrological regime is determined by interactions between several factors. Moreover, water plays a significant role in shaping landscapes. It influences:

- the stability of the landscape
- the safety and hazard potential of the landscape
- the utilization and usability of the landscape

Ecosystems

The construction and operation of ski slopes may affect various ecosystems or biotopes with their caracteristic species. Essentially, these are:

- bodies of water
- wetland and water biotopes
- forests
- montane and subalpine tall herb communities and scrubland
- subalpine dwarf shrub heaths
- alpine grasslands (chalk grassland, silicate grassland, wind-swept ridges) and avalanche grassland
- snowland sites
- rock debris deposits and screes
- rock biotopes
- glacial moraine biotopes
- biotopes shaped or resulting from cultivation (high-nutrient and low-nutrient grassland, pastures, hedges, groves, etc.)

A biotope survey is usually performed before new ski resorts and ski slopes are established or existing ones are expanded. Special sites with very vulnerable or even endangered communities have to be protected.

The ecosystems that are most frequently affected and relevant in terms of water management are discussed below.

Bodies of water

The construction and operation of ski slopes may adversely affect running and standing waters because of intensified runoff and erosion on the one hand and structural measures on the other hand. During the construction and operation of ski slopes care has to be taken to ensure that the ecological integrity of the bodies of water concerned (*maintenance of all internal and external community processes and attributes, interacting with the environment in such a way that the biotic community corresponds to the natural state of the relevant aquatic habitat, ÖNORM M 6232*) is not impaired or only insignificantly impaired.

The following measures and interventions implemented in the course of the construction and/or operation of ski slopes **may** significantly disturb the ecological integrity of running waters in the vicinity of ski slopes:

- Crossings of running waters by ski slopes (bridges, pipes, etc.)
- Regulation measures and changes in runoff conditions
- Withdrawal of water for snowmaking, including the construction of withdrawal structures
- Catchment and diversion of small running waters and/or drainage of wetlands

- Obstacles to migration (weirs, ground sills, water withdrawal structures for snowmaking)
- Sealing of riverbeds and areas around bodies of waters by regulation measures
- Loss of wetlands bordering on the water body
- Changed light regime in case of piped running waters
- Increased input of solids resulting from ski slope erosion

Forest

The condition of forests has to be taken into account in planning as it can only be changed on a very long-term basis.

The evaluation of forest functions takes into consideration

- forest structure and stability,
- state and dynamism of rejuvenation,
- vitality, damage and diseases, and
- silvicultural measures

in order to provide an assessment on aspects such as:

- local importance for protecting assets (living areas/habitats, infrastructure, etc.)
- protection against avalanches,
- risk of rockfalls,
- risk of floods, and
- wind-breaks.

In addition, the habitat and recreational functions of forests have to be assessed separately.

Vegetation

The extent to which organized skiing affects vegetation mainly depends on the baseline condition of the vegetation cover, exposure, terrain, altitude and the duration of snow cover (natural or technical snow). All those factors significantly influence vegetation and its regenerative capacity.

On principle, consideration has to be given to the vegetation cover during planning and construction, including:

- protection of biotopes of high ecological value,
- careful treatment of less valuable biotopes,
- consideration of sites of endangered plants,
- immediate recultivation of sites where the terrain was modified using seeds of native plants adapted to the site, and
- continuous maintenance and care of the vegetation cover.

Wildlife

The practice of winter and summer sports influences wildlife habitats by creating dividing lines and reducing resting areas on the one hand and by disturbances resulting from sports on the other hand. On principle, these concerns already have to be taken into account in planning the project in order to prevent negative consequences.

Suitable measures are:

- creation and maintenance of
  - resting areas for wildlife
  - off-limits areas (access bans, prevention of off-piste skiing)
- improvement of biotopes and small-scale structures valuable for wildlife ecology
- relocation and/or establishment of feeding sites for game
- accompanying forestry and pasture management adjusted to habitats and sites
- raising public awareness by means of appropriate signposts and/or communications
- measures to reduce sources of disturbance (e.g. backcountry skiing, snowshoeing, air sports, mountain biking)

During the planning and construction of ski slopes priority is to be given to protecting landscape and its functions as much as possible. Planning has to minimize interventions into landscape – both above and below the timberline – and thereby prevent long-term ecological effects (collateral and consequential damage, erosion, avalanches, floods, landslides, destruction of vegetation cover, impairment to the habitat of rare plant and animal species, disturbance of ecological balance).

Principles for planning ski slopes, lifts and snowmaking systems

In the project design phase for ski slopes, the following points should be taken into consideration in order to prevent or minimize negative impacts. This guidance on environmentally friendly construction applies both to new developments (route planning, construction up to completion) and existing facilities (maintenance, improvement, rehabilitation).

1. **Planning the route of ski slopes:**
   In all deliberations on the construction of ski slopes, an essential requirement is the identification of the planned ski slope centerline and the exact marking of the slope's boundaries (directly before the start of clearing work) both in and outside wooded areas so that the slope widths stipulated (e.g. by clearing permits under forestry law) are complied with. Within the framework of project design, silvicultural management (launch of rejuvenation) and the implementation of technical measures (e.g. installation of fences) should already be planned and initiated in order to ensure and stabilize the progress of rejuvenation in the area bordering on the ski slopes in the long term.

2. **Adjusting the ski slope to the natural terrain to a large extent:** Preference is to be given to ski slope variants that do not require leveling. Small-scale terrain modifications can be tolerated. This also results in slopes that are more varied for skiers. The advantages of this approach are:

- low-impact soil preparation
- conservation of natural vegetation
- maintenance of the soil's water absorption capacity
- prevention of increased erosion
- better recultivation success
- minimized impact on the scenery

3. **Minimizing terrain modifications:**
Terrain modifications should be limited to those necessary for eliminating hazards for skiers. In general, preference should be given to using **earthmovers** as this makes it possible to adjust the ski slopes to the terrain with relatively low impacts. It is essential that the material removed is well separated and the topsoil is stored in the course of construction work, which has positive effects for recultivation measures. Another advantage of using earthmovers for construction work is that collateral damage is minimized (prevention of rockfalls). As a result, the vitality of stands located along the ski slopes is maintained and, at the same time, they are less prone to consequential damage (windthrow, windfall, annosus root rot).

4. **Minimizing interventions into bodies of water, preventing any essential disturbance of ecological integrity:**
The following aspects have to be taken into consideration:

- Terrain modifications have to be avoided in the vicinity of running water sections and wetlands that are of particular ecological value.
- The piping of running waters has to be avoided; if overpasses across running waters are absolutely necessary for the construction of ski slopes, it has to be ensured that at least the riverbed remains unsealed at the bottom and the dimensions of the passage are sufficiently wide (sufficient incident light from both sides).
- Structures needed have to be adjusted to the type of water body and have to be built in line with the objectives of nature-oriented hydraulic engineering.
- Preservation of continuously open and natural riverbeds as far as possible.
- In case of fish waters, drops exceeding 30 cm should be avoided as far as possible (if, in addition to brown trout, there are also freshwater sculpin or common minnow, ramps should be built instead of drops).
- In case consolidation check dams need to be built, stone crib dams are to be preferred to concrete dams (migration of benthic organisms).
- Where bridges are built, migration opportunities have to be maintained; paths for small animals have to be created.
- During construction work, all the precautions necessary have to be taken to prevent substances harmful to the aquatic habitat (e.g. cement, non-set concrete, mineral oils) from being released to running waters.
- In the course of ski slope construction, stagnant water bodies may be used as retention facilities provided that natural water level fluctuations and water quality are not changed significantly.
- As a rule, the morphology of the water body (shape and surface of beds and banks) should not be modified (no regulation or embankments).
- Special zoological or botanical features have to be considered and protected.

- Any existing withdrawals of non-drinking water (e.g. fish ponds, irrigation, cooling water) have to be taken into account. Interventions must not result in negative impacts on water quality or quantity.

5. **Building ski slopes at and above the timberline and tree line:**
If terrain modifications are necessary in this sensitive area, it is advantageous to carefully remove the alpine vegetation cover, including the top soil layer, plug by plug and put it in place again afterwards. If sowing is necessary, alpine seeds have to be used. Because of the very slow development of soil and vegetation in these areas, recultivation is always difficult after grading.

6. **Avoiding excessively steep slopes (more than 60%) and scarps:**
By respecting this principle, collateral damage (due to rockfalls) and erosion can be reduced, costly drainage measures are not needed, there is less damage caused by ski edges and snow groomers, recultivation is more successful, the risk of icing is reduced and ski slopes offer more safety for users.

7. **Avoiding spring horizons, seep puddles and water-bearing slopes:**
By respecting these principles, instable sections (slides, etc.) on ski slopes and costs (drainage) can be reduced. If there is no alternative route, these sections should not be graded, if possible, and additionally, a comprehensive drainage system should be installed.

8. **Planning a site-adjusted drainage system:**
As far as possible, surface drainage should be avoided in slope-side stands in case of instable soil and subsoil conditions in order to prevent landslides and accumulation. In such areas, it is preferable to safely discharge surface runoff via erosion-protected slopes in natural channels. The number and dimensions of drains located on ski slopes have to be adjusted to the terrain, the vegetation's state and the slope width in line with the relevant precipitation model differentiated by biogeophysical factors.

9. **Planning ski paths and traverses:**
If ski paths are needed, it is recommended to adapt existing forest roads and mountain paths to avoid that existing paths and ski slopes run in parallel and additional forest and grassland is used and to minimize collateral and consequential damage caused by rockfalls and erosion.

10. **No ski paths if they encourage off-piste skiing in forests:**
This principle should be respected especially because of particularly intensive skiing in low-density treetop stands resulting in damage caused by ski edges. If necessary, fixed barriers have to be installed on the downhill side.

Drainage of water from the ski slope area

The following requirements have to be met to minimize damage:

- Bedload source areas must not be further mobilized.
- If possible, the runoff water is to be drained into the ground in adjacent areas or discharged safely.
- Discharges must not result in any significant deterioration of natural conditions related to erosion, slope stability and runoff.
- If water is channeled off, consideration has to be given to used springs.
- Slope-side forest stands must not be impaired by the deposition (accumulation) of eroded material (surface drainage).
- Revegetation areas must not be endangered by erosion.

Recultivation

Recultivation needs result from the area- and location-specific extent of landscape destabilization, the increase in hazard potentials as well as from the demand for re-establishing the original appearance and character of the landscape. Recultivation needs also directly and indirectly include the maintenance of the yield potential of the soil and landscape.

Recultivation covers a package of measures; individual measures range from the calculation of water erosivity to the optimization of soil conditions and revegetation.

Utilization, control and maintenance of facilities

Apart from ski slope planning and construction in line with the state of the art (best available technology), the continuous monitoring and maintenance of the facilities by the operator is of utmost importance to ensure their sustained functioning and the prevention of impacts.

Ski pistes located on soil at risk from treading and steep slopes should not be grazed by heavy livestock. If necessary, the ski slope should be mowed.

Utilization of ski slopes

In the settlement area of mountain farmsteads, ski slopes are used for mowing and grazing during the growing season.

The mowing of meadows growing abundantly on ski slopes also constitutes a significant maintenance activity. It prevents that the sward is stifled by an excessive build-up of dead plant matter above ground. Moreover it contributes to a more even composition of the sward by curbing species that grow too fast or too tall and by promoting species that are less tall and it regulates runoff. As a result, the meadows look well-tended. This is desirable especially in settlement areas.

Grazing promotes the development of revegetated ski slopes towards a natural state more than mowing. Ski slopes with soils at risk from treading (wet or clayey soils) or at very steep sites should not be used for grazing. Consideration has to be given to an appropriate density and type of livestock (grazing habits, weight).

Grazing may start in the second year after sowing if an adequate vegetation cover has been reached.

OITAF Expert Committee VII

International Organization for Transportation by Rope

CO_2 and energy savings

Guidance for Good Practice

The present paper is to support all parties involved both in the design phase and in the operational phase. It is to help consider issues relevant for the operation of ski resorts with ropeways and related infrastructure, including restaurants and bars, already during project design so that it is ensured that subsequent operation is efficient and environmentally friendly, reduces CO_2 emissions and saves energy.

Please note that the extent to which this paper is to be used has to be individually assessed for each resort and each company with utmost attention having to be given to special regional and local aspects.

Introduction

To define a manageable framework for this exercise, ropeway companies can determine their carbon footprint exclusively for the areas in their direct responsibility.

This means that the calculation of the carbon footprint must not take account of CO_2 emissions resulting from tourist arrivals and departures, accommodation, spa services, restaurants and bars as well as other tourism infrastructure.

As a realistic starting point for the determination of the carbon footprint, calculations are to begin at the “turnstile”, i.e. the access to the skiing area proper.

This is justified by the fact that from that point on, the operator of a skiing area can influence its activities to such an extent that impacts on the carbon footprint are under its own control. With regard to the carbon footprint, it also has to be borne in mind that tourists visiting a region came first. It is only then that relevant amenities, such as ropeways, hotels and spas, were added to raise the region’s attractiveness. Consequently, it is not a ropeway operator but the tourists themselves who cause environmental impacts in a region.

When you look at the presentations of the carbon footprint of ropeway companies, they usually aim at highlighting the impacts resulting from skiing. However, information on the carbon footprint is of much greater importance to the operators themselves because they can be very helpful for saving energy, using energy efficiently and stepping up investment to improve installations. As customers are also confronted with circulating carbon footprints, OITAF’s Environmental Expert Committee especially considers that international comparability and transparency is of great importance.

Against this backdrop, a model project supported by Skilifte Lech was launched by the University of Natural Resources and Applied Life Sciences (Vienna, Austria) together with OITAF's Environmental Expert Committee and in cooperation with the Federal Environment Agency of the Republic of Austria (Mobility and Noise Department). The objective of this project is to develop a suitable methodology and to illustrate by means of examples what can be achieved with the help of carbon footprint information from the perspective of enterprises.

In a complex company such as Skilifte Lech, CO_2 emissions are calculated by means of a computer-based model. The Global Emission Model of Integrated Systems (GEMIS) that has been adapted for Austria by the Federal Environment Agency allows for the calculation of the environmental impacts of different systems and their comparison. All the key processes, such as production of raw materials and primary energy as well as transport emissions, are input into the calculation of CO_2 equivalents (quantities of CO_2 and other greenhouse gas emissions, e.g. CH_4, N_2O, perfluoromethane, perfluoroethane). In contrast to conventional consumption data, these quantifications take account of upstream processes. To illustrate the model, an example is given below for Skilifte Lech based on consumption data for the winter seasons 2008/09, 2009/10 and 2010/11.

The calculation of the carbon footprint of Skilifte Lech covers all the installations operated by the company. The company uses electricity to operate ropeways, snowmaking equipment, stations and the company's own restaurants and bars. Diesel is used by snow groomers and agricultural machinery. District heating, solar panels and geothermal energy is used to heat buildings. Moreover, account was taken of further energy and material consumption by workshops, photovoltaic systems, oversnow vehicles as well as consumables, such as oils, greases and detergents.

An overall analysis of the three years used for calculations shows that CO_2 equivalents decreased in all sectors of the company in recent years. Snowmaking is an exception as its share increased significantly. In the following seasons, there was already a reversal of this trend – natural snowfall and temperature conditions at the time of snowmaking are decisive in this context and vary from year to year.

A certain difference may also result from the length of the season, i.e. the number of days in the season.

Apart from electricity consumed by ropeways, diesel consumption also causes high CO_2 equivalents. Diesel accounts for the second highest share in overall emissions. Ski resorts that operate diesel-powered installations have considerable reduction potentials.

For example, the CO_2 equivalents of the electricity mix generated by Vorarlberger Kraftwerke that supplies power to Skilifte Lech (0.177 kg/kWh) are below the Austrian average (0.231 kg/kWh) because of a high percentage of renewable energies. If power is supplied by coal or nuclear power plants, the carbon footprint will be different.

Reduction potentials

Reduction potentials can be tapped by decreasing resource consumption in absolute terms on the one hand and by switching to energy from environmentally friendly sources on the other hand. The biggest items relate to electricity and diesel consumption and another area is the heating of buildings, including hot water supply. These fields are analyzed in detail below.

Electricity

Snowmaking has a significant impact on power consumption – in the case of Skilifte Lech, for example, it accounts for approx. 52% of the electricity used. Improvements resulting from the consistent and continuous improvement of the overall system and upgrades to the state of the art are particularly effective. In addition, measures for resort-wide snow management (GPS-based measurement of snow heights) have a positive effect on energy consumption.

Depending on local conditions, turbines generating electricity can also be installed in the pipelines of snowmaking systems. For example, the ropeway operator of Oberstdorf uses such a power plant to produce 33% of its annual electricity consumption.

With regard to the carbon footprint, a switch to green power offers further reduction potentials.

Efforts made in the photovoltaic field help raise awareness and demonstrate commitment to renewable energies.

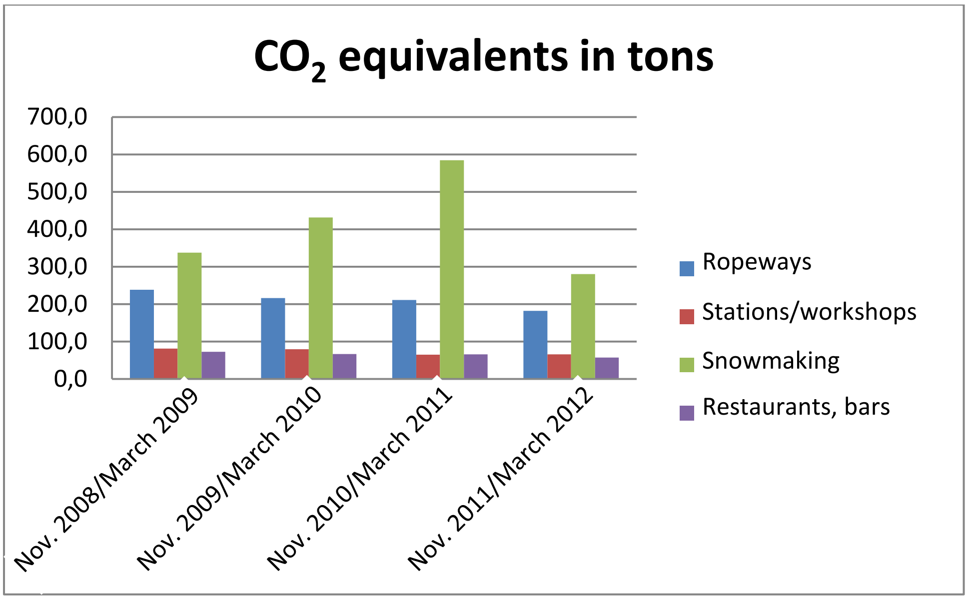


Figure 1: Electricity consumption in tons of CO_2 equivalents by sector for November to March of the seasons 2008-2012 (Skilifte Lech)

Table 1: Electricity consumption in tons of CO2 equivalents for November to March of the seasons 2008-2012 (Skilifte Lech)

	Tons CO_2 equivalents			
Categories of electricity consumption	**Nov. 2008/ March 2009**	**Nov. 2009/ March 2010**	**Nov. 2010/ March 2011**	**Nov. 2011/ March 2012**
Ropeways	238.9	216.3	211.6	182.4
Stations/workshops	81.2	80.0	65.3	66.0
Snowmaking	338.0	431.2	584.1	280.3
Restaurants and bars	72.8	66.9	66.1	57.8
Total	**730.9**	**794.5**	**927.1**	**586.5**

Note: The emissions of the photovoltaic system are allocated to ropeways.

Note: The period from November to March was selected owing to the quality of the data available.

Diesel

Diesel is mainly used for slope grooming. Fleet management, training for optimized driving and in-house incentive schemes contribute to considerable savings.

Improvements are to be expected when environmentally friendly fuels are used and technical innovations are consistently implemented in drive systems.

It has to be borne in mind that biofuels are suitable for use in winter only to a limited extent. However, they are a viable option for agricultural machinery (slope maintenance in summer).

Heating of buildings

With regard to CO_2 equivalents, excellent results can be achieved not only by structural measures (thermal insulation of buildings) but also by the use of regional resources and efficient heating systems and controls. Biomass can be considered a low-emission fuel in comparison with other fuels. Further reductions are achieved by means of heat pumps (geothermal energy) and the use of solar panels for providing hot water.

Relevance of the results

The information provided by carbon footprint calculations proves to be well suited for identifying measures related to energy consumption and environmental stewardship.

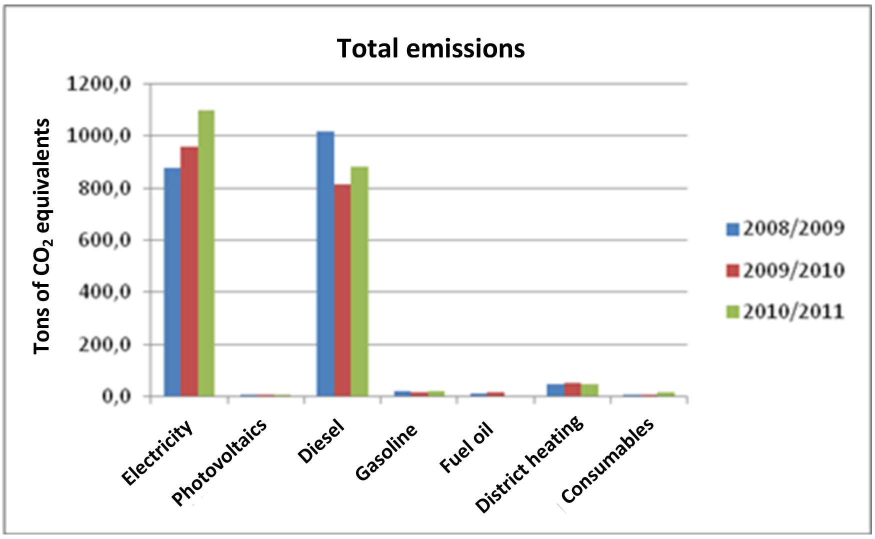


Figure 2: Development of greenhouse gas emissions in t CO_2 equivalents 2008/09, 2009/10, 2010/11 (Skilifte Lech)

OITAF Work Committee VII

International Organization for Transportation by Rope

Energy efficiency in ropeway companies

Guidance for Good Practice

Building on the **"Leitfaden für Schigebiete"** (guidance for ski resorts published by the Austrian Ministry of Agriculture and Forestry, Environment and Water Management in 2006), **"Leitfaden für das Klima- und Energiekonzept im Rahmen von UVP-Verfahren"** (guidance on the climate and energy concept in the framework of EIA procedures) and the **"Empfehlung eines Weges zur Energieeinsparung im Unternehmen"** (recommendation on how to save energy in enterprises) and the study **"Energiemanagement bei Bergbahnen" (energy management for mountain ropeways, Switzerland)** this paper tries to present measures raising energy efficiency in ropeway companies.

The objective is to optimize the use of available resources, such as water, electricity and fossil fuels as well as personnel and machinery.

1. Current situation of energies used and their sources

In a first step, the fuels and energy resources mainly used (energy supply from fossil fuels and/or renewable energies) are listed and detailed:

1.1 General activities

- Energy supply contracts
- Power consumption of aerial ropeways and lifts (overall consumption, consumption by time of day)
- Water and energy consumed by snowmaking infrastructure
- Fuel consumed by the vehicle fleet (tractors, snow groomers, etc.)
- Energy consumed in offices/ticket offices/workshops
- Energy consumed by own restaurants and bars
- Energy consumed by heating systems
- Own energy production (hydro power, solar, wind and geothermal energy)
- Heat recovery (ropeway drives, exhaust air from restaurants and bars)

1.2 Electricity

- Power supply (subscribed capacity, etc.) and information on reserve capacities
- Information on parallel operation of ropeways and snowmaking systems. Information on whether and when there are (will be) peaks in power consumption
- Recording of network losses for transformer stations outside operating hours

- Recording of reactive current

1.3 Fossil fuels

- Quantity [t/a, l/a] and quality of fuels
- Technical description of the systems installed for using fossil fuels (installed power, full-load hours per year, energy output in kWh per year)

1.4 Renewable energies

- Hydro power, solar thermal energy, photovoltaics, wind energy, biomass, biofuels, etc.
- Quantity [t/a, l/a, kWh] and type of renewable energies produced or purchased
- Quality of biomass
- Technical description of the systems installed for using renewable energies (installed power, full-load hours per year, energy output in kWh per year)

2. Information on energy requirements of buildings, plant, machinery and tools

- Ropeways
- Snowmaking systems
- Other equipment and machinery (vehicles, motors, pumps, etc.)
- Lighting of sports facilities and buildings
- Building services (restaurants, hotels, service providers, etc.)
- Operating hours and output per day and season, separately for the winter and summer season for the maximum operating period

3. Information on energy efficiency based on indicators

- Ropeways (e.g. energy consumption per passenger carried and/or per passenger kilometer/mile in altitude)
- Snowmaking systems (e.g. energy consumption per m^3 of snow)
- Other equipment and machinery (snow groomers, engines, pumps), e.g. EURO classes
- Lighting (e.g. information on energy labeling)

4. Analysis of operating processes

- Preparation of an energy balance sheet
- Peak consumption management: Check of whether and how often the consumption agreed with the supplier is exceeded - *Destination monitoring*
- Snow grooming: Fleet management/snow depth measurement
- Review of the use of all vehicle types – energy efficiency
- Snowmaking concept/snow management: How much snow has to be produced per hydrant/slope site in order to establish and maintain optimum

conditions on the ski slope and to have sufficient reserves without producing too much snow?
- Ropeways: Adjustment of speed to the number of passengers and the number of carriers
- Operation of restaurants and buildings: Peak consumption management
- Application rules for employees

5. Measures

5.1 Organizational measures

With a view to the items listed above, the following points are relevant for monitoring and improving energy efficiency:

- Introduction of demand-based ropeway operation
- Consideration of the energy efficiency of all types of products
- Prioritizing of energy-saving drives for new installations
- Use of suitable software for monitoring and recording energy consumption per ropeway/station/... consumption point (basis for comparing several operating years)
- Records on the operating duration of various installations
- Check of electricity bills
- Training of employees on opportunities for energy saving
  - Heating and ventilation of rooms
  - Operation of the control systems of installations/equipment
  - Efficient use of energy and water

5.2 Structural and technical measures

- Thermal insulation of buildings
- Automation and optimization of heating systems
- Heat recovery (installation of heat exchangers, drive units of ropeways, restaurants, etc.)
- Optimization of ventilation systems
- Own production of electricity and heat
  - *Use of snowmaking systems for generating electricity*
  - *Use of small hydropower plants*
  - *Pumped-storage power plant — appropriate in case of a usable storage capacity of more than 500,000 m³ of water*
  - *Operation of photovoltaic systems*
  - *Use of deep geothermal heat*
  - *Use of solar thermal energy to supplement the heating system*
  - *Use of wind energy*

6. Reduction of energy supply costs

- Review of power supply contracts
- Introduction of a purchasing pool with several buyers
- Optimization of the ceiling for electricity purchasing; agreement with power suppliers, more flexibility with regard to timing
- Peak load management (to avoid that the ceiling for electricity purchasing is exceeded)
- Limitation and reduction of consumption (temporal and temperature-dependent scheduling of the operation of individual power consumers, e.g. pit heating systems)
- Integration of emergency power generators

The information gathered for the above points and the resulting actions provide a comprehensive basis for optimizing the use of the resources available in ski resorts (ropeways, restaurants, etc.) and their environment.