SMART ALTITUDE

Wi-EMT

Evaluation Report

Ski resort: xxx (yyy)

"This project is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme".

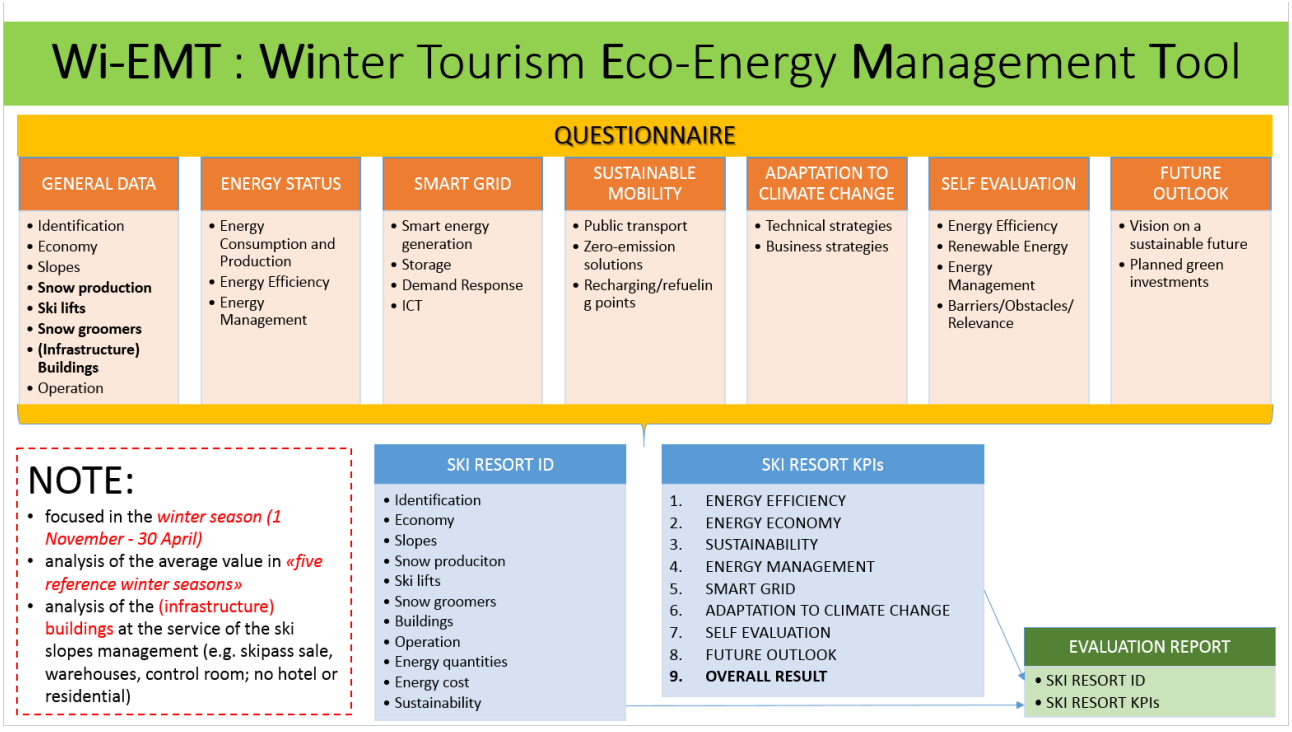
Introduction

Wi-EMT is an audit tool for the ski resort operators to evaluate the ecological, energetic and management status, identifying the priorities of intervention in a comparative perspective with other ski resorts.

The input data are collected from a **QUESTIONNAIRE** filled by the ski resort. The questionnaire is a self-evaluation questionnaire and it is not validated by any third part. Each ski resort doesn't know the specific parameters of others, keeping them confidential.

The outputs are:

- **SKI RESORT ID**: main features that characterize the size, infrastructures and operation of the ski resort.
- **SKI RESORT KPIs**: measurable values that demonstrates how effectively the ski resort is achieving key business objectives.
- **EVALUATION REPORT**: it is a report that include the ski resort ID and the ski resort KPIs. In this way it provides supervision of the level of energy efficiency, sustainability and management in the ski resort and compares its performance with an Alpine Space reference. Beside a supervision and a comparison of the performance, the report provides a value database for further measurements of energy improvement, able to strengthen competitiveness at international scale. The Evaluation Report is divided into 9 main sections (Energy Efficiency, Energy Economy, Sustainability, Energy Management, Smart Grid, Adaptation to Climate Change, Self Evaluation, Future Outlook, Overall Result). In each main section the ski resort achieves a specific result (called KPI - Key Performance Indicator) within the range 0-5, where a KPI = 0 means that the ski resort is the worst and KPI = 5 means that the ski resort is the best among the involved ski resorts. Please note that the greater the number of ski resorts involved, the greater the significance/accuracy of the results. In addition to the various KPIs of the different sections, a purely quantitative analysis is offered.



QUESTIONNAIRE

The Smart Altitude Questionnaire utilised to collect data from the ski resorts is divided in 7 sections. The structure is shown below:

SECTION	SUBSECTION	COLLECTED DATA
GENERAL DATA	Identification	Ski resort name, country, region, municipality, altitude, heating degree days
	Economy	Turnover
	Slopes	Length, surface, drop
	Snow production	n. snow guns, n. snow lances, m^3 of produced snow, m^3 of water storage, m^3 of water concessions
	Ski lifts	n. & length of moving carpets, draglifts, fixed grip chairlifts, fixed grip Gondola lifts, detachable chairlifts, detachable Gondola lifts, total drop, maximum transport capacity, total operative hours, total n. of entrances
	Snow groomers	n. of snow groomers, treated surface, drop
	Buildings	Area
	Operation	Days of operation, skier-days, visitors
ENERGY STATUS	Energy Consumption & Production	Electrical consumption and cost (total, snow production, ski lifts, buildings, from the grid), PV production and use, wind production and use, hydro production and use, CHP production and use, Gas consumption and cost, LPG consumption and cost, Oil consumption and cost (total, snow groomer, buildings, other), biomass consumption and cost, heat pump use, DH consumption and cost, solar thermal production
	Energy Efficiency	Energy efficiency improvement on snow production, ski lifts, snow groomers, buildings; % of en.red., additional/mandatory
	Energy Management	EMS type and use, preventive maintenance, dedicated office, quality standards, eco-labels
SMART GRID		Smart electric generation
		Power to heat
		Power to gas
		Power to mobility
		Electric storage
		Demand Response
		ICT for monitoring
		ICT for prediction
		ICT for control
SUSTAINABLE MOBILITY		Public transport availability to reach the ski resort
		Public transport availability to move within the ski resort
		Zero-emission solutions
		E-charging/H2-refuelling points availability
		Direct integration of RES at recharging/refueling points

ADAPTATION TO CLIMATE CHANGE	Technical strategies	Increase snowmaking
		Protection of snow and glaciers to avoid summer melting
		Increase the number of north facing ski slopes
		Increase the number of ski slopes at higher altitudes
	Business strategies	Invest in revenue diversification
		Nocturnal skiing
		Collaborations with other ski resorts
		Marketing strategies
SELF EVALUATION	Energy Efficiency	Relevant topic, doing well, impact, collaborations with external partners, obstacles
	Renewable Energy	Relevant topic, doing well, impact, collaborations with external partners, obstacles
	Energy Management	Relevant topic, doing well, impact, collaborations with external partners, obstacles
	Barriers/Obstacles/Relevance	No idea of measures, time&staff, missing ext. support, financial issues, long pay-back, relevance of energy cost, problems with interruption of activities
FUTURE OUTLOOK	Vision on a sustainable future	Energy cost, energy resources, climate change/environmental issues, European policy
	Planned “mitigation” investments	Energy efficiency, RES, EMS, smart grid, sustainable mobility, accepted pay-back
	Planned “adaptation” investments	Technical strategies, business strategies

Moreover, the following considerations have been applied in this survey:

- The analysis of the ski resort is focused in the winter season (1 November - 30 April).
- Where applicable, the analysis is based on "five reference winter seasons", collecting the average value of the five most recent years, to mediate climate variability (natural snow, temperature...).
- In all the answers are considered only the buildings at the service of the ski slopes management (e.g. skipass sale, warehouses, control room; no hotel or residential).
- Finally, in the subsection "Energy Consumption & Production" are considered only the energy consumption of the ski slopes management (snow production, ski lifts, snow groomers, service buildings; not hotel or residential) and the energy production systems owned by the ski slope operator used for the ski slopes management (e.g. snow production, ski lifts, snow groomers, service buildings ; not hotel or residential).

SKI RESORT ID

From the questionnaire are selected the main information that characterizes the analyzed ski resort. In a quick and intuitive way it is therefore possible to have a comprehensive overview of the size of the resort, of the main infrastructures and of the operating conditions.

IDENTIFICATION		
Ski resort name		xxx
Country		yyy
Minimum altitude of the slopes	m a.s.l.	
Maximum altitude of the slopes	m a.s.l.	
Average altitude of the slopes	m a.s.l.	
Average heating degree days	HDD	
ECONOMY		
Winter season turnover	€	
SLOPES		
km of slopes	km	
Surface of slopes	m^2	
Drop of slopes	m	
SNOW PRODUCTION		
Number of snow guns		
Number of snow lances		
m^3 of produced snow	m^3	
m^3 of water storage in basins dedicated to snowmaking system	m^3	
m^3 of water concessions from the water supply network	m^3	
SKI LIFTS		
km of moving carpets	km	
km of draglifts	km	
km of fixed grip chairlifts	km	
km of fixed grip Gondola lifts	km	
km of detachable chairlifts	km	
km of detachable Gondola lifts	km	
Total drop in the winter season	m	
Overall maximum transport capacity	passengers/h	
Operative hours in the winter season	h	
Number of entrances in the winter season		
SNOW GROOMERS		
Number of snow groomers		
Overall treated surface in the winter season	m^2	
Overall total drop in the winter season	m	
BUILDINGS		
Buildings area	m^2	
OPERATION		
Days of operation in the winter season	days	
Overall skier-days in the winter season		
Number of visitors in the winter season		
ENERGY QUANTITIES		
Total energy consumption in the winter season	kWh	
Total electricity consumption in the winter season	kWh	
ENERGY COST		
Purchased energy commodities in the winter season	€	
Purchased grid electricity in the winter season	€	
SUSTAINABILITY		
Use of renewable energy sources in % of total energy consumption	%	
CO2 emissions in the winter season	t CO2	

SKI RESORT KPIs

Filling the Smart Altitude Questionnaire it is possible to get measurable values that demonstrates how effectively the ski resort is achieving key business objectives.

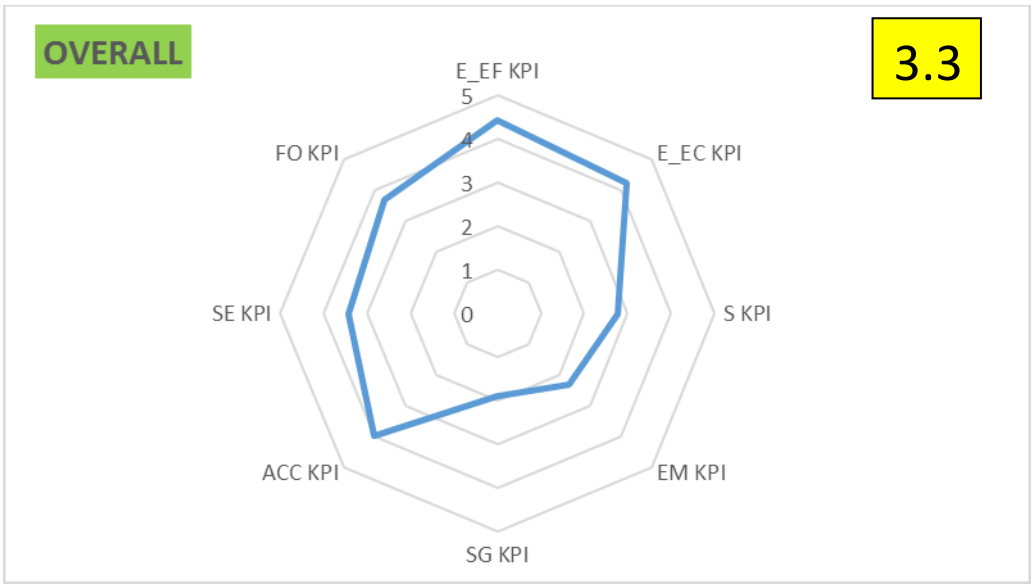
The overall amount of designed KPIs is 54, divided into 9 sections.

The widest sections are the *Energy Efficiency* and the *Energy Economy* where are analysed the energetic and economic performances of the overall ski-resort, snow production, ski-lift, snow groomers and buildings. Overall performances are summarised with the Overall Energy Efficiency KPI and the Overall Energy Economy KPI. For these two KPIs a benchmarking analysis is applied comparing the data of all the ski resorts participating in the survey.

Another section is the *Sustainability* section where is analysed the percentage of renewable energy utilised in the area, the amount of carbon dioxide emitted and the sustainable mobility attitude. Overall performances are summarised with the Sustainability KPI. For this KPI a benchmarking analysis is applied comparing the data of all the ski resorts participating in the survey.

In the *Energy Management, Smart Grid, Adaptation to Climate Change, Self Evaluation and Future Outlook* sections are performed weighted averages of scores from the homonyms sections of the Questionnaire to get the KPIs.

As last, the *Overall Ski-Resort KPI* it is designed as average of scores from all the previous sections.



E_EF: Energy Efficiency; E_EC: Energy Economy; S: Sustainability; EM: Energy Management; SG: Smart Grid; ACC: Adaptation to Climate Change; SE: Self Evaluation; FO: Future Outlook

KPI COD	KPI CALCULATION	VALUE	UNIT	DESCRIPTION
ENERGY EFFICIENCY & ECONOMY				
Overall ski-resort				
1	Ctot/TO		%	Estimates the relative weight of purchased energy commodities with respect to the turnover
2	Cel/TO		%	Similar to index 1, but restricted to grid electricity
3	Etot/TO		kWh/€	Total energy intensity
4	Eel/TO		kWh/€	Electrical energy intensity
5	Etot/SD		kWh/SD	Total energy consumption per skier-day
6	Eel/SD		kWh/SD	Similar to index 5, but restricted to electricity
7	Ctot/SD		€/SD	Total energy cost per skier-day
8	Cel/SD		€/SD	Similar to index 7, but restricted to grid electricity
9	Etot/d		kWh/day	Total energy consumption per working day
10	Eel/d		kWh/day	Similar to index 9, but restricted to electricity
11	Ctot/d		€/day	Total energy cost per working day
12	Cel/d		€/day	Similar to index 11, but restricted to grid electricity
13	E_EF OSR KPI		1…5	Weighted average of scores from "overall ski-resort" energy efficiency KPIs (Benchmarking Methodology)
14	E_EC OSR KPI		1…5	Weighted average of scores from "overall ski-resort" energy economy KPIs (Benchmarking Methodology)
Snow production				
15	Eel_{SP}/VSP		kWh/m3	Electricity consumption for snow production per m3 of produced snow
16	Cel_{SP}/VSP		€/m3	Energy cost for snow production per m3 of produced snow (assuming the el. grid price)
17	E_EF SP KPI		1…5	Weighted average of scores from "snow production" energy efficiency KPIs (Benchmarking Methodology)
18	E_EC SP KPI		1…5	Weighted average of scores from "snow production" energy economy KPIs (Benchmarking Methodology)
Ski-lift				
19	Eel_{SL}/(TD)		kWh/km	Electricity consumption for ski lifts per km of drop
20	Cel_{SL}/(TD)		€/km	Energy cost for ski lifts per km of drop (assuming the el. grid price)
21	Eel_{SL}/(NE)		kWh/E	Electricity consumption for ski lifts per entrance
22	Cel_{SL}/(NE)		€/E	Energy cost for ski lifts per entrance (assuming the el. grid price)
23	Eel_{SL}/(TD*NE)		kWh/(1000km*1000 E)	Electricity consumption for ski lifts per 1000 km of drop and 1000 entrance
24	Cel_{SL}/(TD*NE)		€/(1000km*1000E)	Energy cost for ski lifts per 1000 km of drop and 1000 entrance (assuming the el. grid price)
25	E_EF SL KPI		1…5	Weighted average of scores from "ski-lift" energy efficiency KPIs (Benchmarking Methodology)
26	E_EC SL KPI		1…5	Weighted average of scores from "ski-lift" energy economy KPIs (Benchmarking Methodology)
Snow groomers				
27	E_{SG}/(TS)		kWh/km2	Energy consumption for snow groomers per km2 of treated slope
28	Ce_{SG}/(TS)		€/km2	Energy cost for snow groomers per km2 of treated slope
29	E_{SG}/(GD)		kWh/km	Energy consumption for snow groomers per km of drop
30	Ce_{SG}/(GD)		€/km	Energy cost for snow groomers per km of drop
31	E_{SG}/(TS*GD)		kWh/km3	Energy consumption for snow groomers per km2 of treated slope and km of drop
32	Ce_{SG}/(TS*GD)		€/km3	Energy cost for snow groomers per km2 of treated slope and km of drop

33	E_EF SL KPI		1…5	Weighted average of scores from "snow groomers" energy efficiency KPIs (Benchmarking Methodology)
34	E_EC SL KPI		1…5	Weighted average of scores from "snow groomers" energy economy KPIs (Benchmarking Methodology)
		Buildings		
35	E_{HB}/(BS)		kWh/m2	Heating consumption for buildings per m2 of building surface
36	Ce_{HB}/(BS)		€/m2	Heating cost for buildings per m2 of building surface (assuming the el. grid price)
37	E_{EB}/(BS)		kWh/m2	Electrical consumption for buildings per m2 of building surface
38	Ce_{EB}/(BS)		€/m2	Electrical cost for buildings per m2 of building surface (assuming the el. grid price)
39	E_B/(BS*HDD)		kWh/(m2*HDD)	Energy consumption for buildings per m2 of building surface and heating degree day
40	Ce_B/(BS*HDD)		€/(m2*HDD)	Energy cost for buildings per m2 of building surface and heating degree day (assuming the el. grid price)
41	E_EF B KPI		1…5	Weighted average of scores from "buildings" energy efficiency KPIs (Benchmarking Methodology)
42	E_EC B KPI		1…5	Weighted average of scores from "buildings" energy economy KPIs (Benchmarking Methodology)
		Overall Energy Efficiency & Economy KPI		
43*	E_EF B KPI		1…5	Weighted average of scores from Energy Efficiency KPIs (Benchmarking Methodology)
44*	E_EC B KPI		1…5	Weighted average of scores from Energy Economy KPIs (Benchmarking Methodology)
		SUSTAINABILITY		
45	(Eren-el+Eren-th+Eren-mob)/Etot		%	Ratio between total renewable energy consumption and total energy consumption (electricity from grid and district heating are considered 100% renewable)
46	CO2/Etot		tCO2/MWh	Tons of CO2 emitted per MWh of energy consumption
47	SM KPI		1…5	Weighted average of scores from the Sustainable Mobility section
48*	ES KPI		1…5	Weighted average of scores from Sustainability KPIs (Benchmarking Methodology)
		ENERGY MANAGEMENT		
49	EM KPI		1…5	Weighted average of scores from the Energy Management section
		SMART GRID		
50	SG KPI		1…5	Weighted average of scores from the Smart Grid section
		ADAPTATION TO CLIMATE CHANGE		
51	ACC KPI		1…5	Weighted average of scores from the Adaptation to Climate Change section
		SELF EVALUATION		
52	SE KPI		1…5	Weighted average of scores from the Self Evaluation section
		FUTURE OUTLOOK		
53	FO KPI		1…5	Weighted average of scores from the Future Outlook section
		OVERALL RESULT		
54*	OV KPI		1…5	Weighted average of scores from Energy Efficiency, Energy Economy, Sustainability, Energy Management, Smart Grid, Adaptation to Climate Change, Self Evaluation, Future Outlook sections (partially applying a Benchmarking Methodology)

* defined applying a Benchmarking Methodology

Smart Altitude

SMART ALTITUDE aims at enabling and accelerating the implementation of low-carbon policies in winter tourism regions. Technical solutions for the reduction of energy consumption and GHG emissions in mountain areas relying on winter tourism today exist, with up to 40% reduction potential. However, key trade-offs are at the heart of their slow uptake: they require stronger and innovative involvement to overpass strategic (goals, priorities, risks), economic (costs, financing) and organizational (partnership, stakeholder involvement) challenges.

SMART ALTITUDE will demonstrate the efficiency of a decision support tool integrating all challenges into a step-by-step approach to energy transition. The project clearly innovates by deploying a comprehensive approach of low-carbon policy implementation based on impact maximization accounting for technical, economic and governance factors. It is based on common performance indicators, monitoring systems (snow processes, municipal infrastructure, renewables, buildings etc.) and Energy Management Systems (EMS) in mountain territories, so as to build a shared situational awareness and take impactful decisions. The approach is implemented in 3 real-field demonstrations and prepares for replication in 20 other Alpine Space territories.

The project targets policymakers, infrastructure operators, investors, tourism and entrepreneurship organisations.

Its outputs are a Territorial diagnosis method, an online Smart Altitude Toolkit, Living Labs, a Planning model for adaptation strategy implementation, a Replication roadmap and a Network of low-carbon winter tourism regions. The partnership and activities ensure the approach suitability across the Alpine Space, promote new innovations and skills, and enable policymakers to plan and prioritize measures increasing the resilience of mountain areas.

MORE INFO:

https://www.alpine-space.eu/projects/smart-altitude/en/home