Key Performance Indicators for the optimization of low carbon measures

– Deliverable D.T1.3 –
Key Performance Indicators report

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European Regional Development Fund

Smart Altitude – Alpine winter tourism territories demonstrating an integrated framework for a low-carbon, high impact and resilient future

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, economic and organizational challenges.
The project 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 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.

SMART ALTITUDE lasts from April 2018 to April 2021 and is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme.

Summary

This report presents all the results associated with the identification, calculation and display of Key Performance Indicators (KPI) related to an ecological, energetic and management evaluation for a ski resort.

A new audit tool, called “Wi-EMT” (Winter tourism Eco-energy Management Tool) has been developed for this purpose.

A questionnaire divided in 7 sections collects the data necessary to assess the KPIs. From this questionnaire and the KPIs evaluation, an individual report is addressed to ski resorts operators.

Moreover, a comparison between different ski resorts is possible based on different macro-indicators.

Other indicators can be daily used for the "low-carbon" operation of a ski resort. Involving an adequate number of ski resorts it is possible to identify average KPIs at national and Alpine Space level. Until now the analysis is limited to the 3 living labs of the Smart Altitude project, but the goal is to involve 20 other ski resorts in order to obtain a statistical basis at the moment unexplored. A relevant selection of KPIs can also be used into an integrated energy management system. At the same time, some average KPIs can be published on public plateforms such as the Smart Altitude WebGIS.

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1. Introduction

The objective of WP1 is to create tools for an integrated dashboard for energy transition in Alpine mountain areas, supporting the prioritization of low-carbon operations. This includes the development of situational awareness, actual performance assessment and Key Performance Indicators.

The activity A.T1.3 is dedicated to Key Performance Indicators (KPI). KPIs are derived from data obtained through the monitoring system (T1.2), validated by a benchmarking questionnaire. They are combined with other performance criteria (GHG impact, number of users, costs, weather return on investment…) so as to reach macro indicators integrated in public plaform such as the WebGIS. This will be the comparable framework to measure performance in real time and in the long term.

This report includes the description of KPIs for low carbon strategies in winter tourism territories, the necessary data needed for their calculation and the way they are calculated and displayed.

2. Implemented methodology

In order to optimize the low-carbon measures to be implemented, it is first necessary to evaluate the current systems performance in each living lab. In this way, an audit that identify a set of KPIs should be performed. For a complete analysis, these indicators should focus on different topics such as energy, environment and management.

All these KPIs offer to ski resort operators the opportunity to:

- Self-diagnose
- Operate energy equipment in place more efficiently
- Prioritize low-carbon strategies

In addition, common macro-indicators can be useful to compare the performance of systems from one ski resort to another.

To evaluate each ski resort performance, a methodology has been implemented including:

- Data collection
- KPIs creation
- KPIs evaluation
- KPIs display and exploitation

Each ski resort has a data set to collect in order to calculate the KPIs. This data, and the way it is collected, differs from one ski resort to another. For example, a resort that uses an energy monitoring system can easily access the needed energy data set. Conversely, it is quite impossible to collect this data for a ski resort that has not implemented a set of energy meters. Based on this observation, the collected data is only currently available data in all of the 3 living labs.

In order to create a set of common KPIs among different ski resorts, it is necessary to harmonize the collected data. From common input data, it is therefore possible to compare KPIs from one ski resort to another. So that, all of the created KPIs are based on the data currently available in each ski resort. Thus, on this common basis, all ski resorts access the same KPIs. Each indicator is therefore not specific to a particular ski resorts but common to all ski resorts.

These data are collected using a questionnaire included in a new audit tool called "Wi-EMT - Winter tourism Eco-energy Management Tool" (Figure 1). Until now, the analysis is limited to the 3 living labs of the Smart Altitude project, but the goal is to involve 20 other ski resorts (called replication sites) in order to obtain a statistical basis at the moment unexplored.

From this questionnaire and the KPI evaluation, an individual evaluation report is addressed to ski resorts operators. A relevant selection of KPIs can also be used into an integrated energy management system. At the same time, average KPIs can be published in the Smart Altitude WebGIS and background information can be found on the WIKIAlps platform.

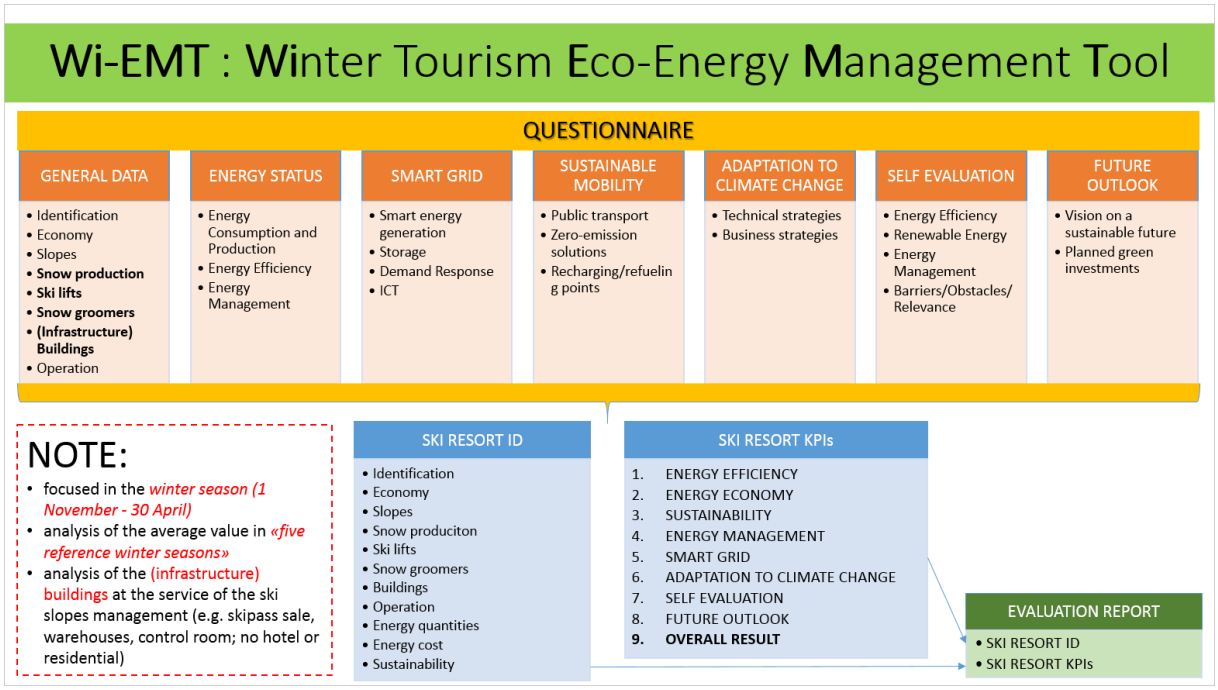

Figure 1 : Architecture of the new audit tool called Wi-EMT

3. Data collection

The input data are collected through a questionnaire filled by each ski resort. The questionnaire is a self-evaluation questionnaire and it is not validated by any third party. Ski resort don't have access to the specific parameters of others, keeping the data confidential.

The Smart Altitude Wi-EMT questionnaire utilised to collect data from the ski resorts is divided in 7 sections. The structure is shown in Table 1.

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

Table 1 : Structure of the Wi-EMT questionnaire for data collection

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

- The analysis of the ski resort is focused on 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…).
- Only the buildings at the service of the ski slopes management (e.g. skipass sale, warehouses, control room; no hotel or residential) are considered in all the answers
- Finally, in the subsection "Energy Consumption & Production" 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) are considered.

4. Key Performance Indicators listing

4.1. Ski resort ID

From the questionnaire are selected the main information that characterizes the analysed 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. The information, divided into 11 sections, is listed in Table 2.

IDENTIFICATION	
Ski area name	
Country	
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	m2
Drop of slopes	m
SNOW PRODUCTION	
Number of snow guns	
Number of snow lances	
m3 of produced snow	m3
m3 of water storage in basins dedicated to snowmaking system	m3
m3 of water concessions from the water supply network	m3
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	m2
Overall total drop in the winter season	m
BUILDINGS	
Buildings area	m2
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

Table 2 : Ski Resort ID: main characteristic data of ski resorts

4.2. Key Performance Indicators

By 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 (Table 3). This KPIs listing includes not only economic, environmental, and energy indicators, but also more global performance criteria.

Thanks to the combination of all these KPIs, it is possible to highlight the best practices for the implementation of low-carbon measures.

The widest sections are the *Energy Efficiency* and the *Energy Economy* where the energetic and economic performances of the overall ski-resort, snow production, ski-lift, snow groomers and buildings are analysed. The Overall Energy Efficiency KPI and the Overall Energy Economy KPI summarizes the overall performances. 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.

KPI COD	KPI CALCULATION	VALUE	UNIT	DESCRIPTION
ENERGY EFFICIENCY & ECONOMY				
Overall ski-resort				
1	Ctot/TO	10.56	%	Estimates the relative weight of purchased energy commodities with respect to the turnover
2	Cel/TO	7.56	%	Similar to index 1, but restricted to grid electricity
3	Etot/TO	0.874	kWh/€	Total energy intensity
4	Eel/TO	0.548	kWh/€	Electrical energy intensity
5	Etot/SD	17	kWh/SD	Total energy consumption per skier-day
6	Eel/SD	11	kWh/SD	Similar to index 5, but restricted to electricity
7	Ctot/SD	2.11	€/SD	Total energy cost per skier-day
8	Cel/SD	1.52	€/SD	Similar to index 7, but restricted to grid electricity
9	Etot/d	65309	kWh/day	Total energy consumption per working day
10	Eel/d	43420	kWh/day	Similar to index 9, but restricted to electricity
11	Ctot/d	8231	€/day	Total energy cost per working day
12	Cel/d	6354	€/day	Similar to index 11, but restricted to grid electricity
13	E_EF OSR KPI	3.3	1…5	Weighted average of scores from "overall ski-resort" energy efficiency KPIs (Benchmarking Methodology)
14	E_EC OSR KPI	3.3	1…5	Weighted average of scores from "overall ski-resort" energy economy KPIs (Benchmarking Methodology)
Snow production				
15	Eel_{SP}/VSP	5.339	kWh/m3	Electricity consumption for snow production per m3 of produced snow
16	Cel_{SP}/VSP	0.742	€/m3	Energy cost for snow production per m3 of produced snow (assuming the el. grid price)
17	E_EF SP KPI	3.3	1…5	Weighted average of scores from "snow production" energy efficiency KPIs (Benchmarking Methodology)
18	E_EC SP KPI	3.3	1…5	Weighted average of scores from "snow production" energy economy KPIs (Benchmarking Methodology)
Ski-lift				

19	Eel_{SL}/(TD)	207	kWh/km	Electricity consumption for ski lifts per km of drop
20	Cel_{SL}/(TD)	26	€/km	Energy cost for ski lifts per km of drop (assuming the el. grid price)
21	Eel_{SL}/(NE)	0.328	kWh/E	Electricity consumption for ski lifts per entrance
22	Cel_{SL}/(NE)	0.046	€/E	Energy cost for ski lifts per entrance (assuming the el. grid price)
23	Eel_{SL}/(TD*NE)	56.978	kWh/(1000km*1000E)	Electricity consumption for ski lifts per 1000 km of drop and 1000 entrance
24	Cel_{SL}/(TD*NE)	7.281	€/(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	3.3	1…5	Weighted average of scores from "ski-lift" energy efficiency KPIs (Benchmarking Methodology)
26	E_EC SL KPI	3.3	1…5	Weighted average of scores from "ski-lift" energy economy KPIs (Benchmarking Methodology)
Snow groomers				
27	E_{SG}/(TS)	14663	kWh/km2	Energy consumption for snow groomers per km2 of treated slope
28	Ce_{SG}/(TS)	1382	€/km2	Energy cost for snow groomers per km2 of treated slope
29	E_{SG}/(GD)	3412	kWh/km	Energy consumption for snow groomers per km of drop
30	Ce_{SG}/(GD)	317	€/km	Energy cost for snow groomers per km of drop
31	E_{SG}/(TS*GD)	27.069	kWh/km3	Energy consumption for snow groomers per km2 of treated slope and km of drop
32	Ce_{SG}/(TS*GD)	2.607	€/km3	Energy cost for snow groomers per km2 of treated slope and km of drop
33	E_EF SL KPI	3.3	1…5	Weighted average of scores from "snow groomers" energy efficiency KPIs (Benchmarking Methodology)
34	E_EC SL KPI	3.3	1…5	Weighted average of scores from "snow groomers" energy economy KPIs (Benchmarking Methodology)
Buildings				
35	E_{HB}/(BS)	79	kWh/m2	Heating consumption for buildings per m2 of building surface
36	Ce_{HB}/(BS)	6.337	€/m2	Heating cost for buildings per m2 of building surface (assuming the el. grid price)
37	E_{EB}/(BS)	145	kWh/m2	Electrical consumption for buildings per m2 of building surface
38	Ce_{EB}/(BS)	18.848	€/m2	Electrical cost for buildings per m2 of building surface (assuming the el. grid price)
39	E_{B}/(BS*HDD)	0.045	kWh/(m2*HDD)	Energy consumption for buildings per m2 of building surface and heating degree day
40	Ce_{B}/(BS*HDD)	0.005	€/(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	3.3	1…5	Weighted average of scores from "buildings" energy efficiency KPIs (Benchmarking Methodology)
42	E_EC B KPI	3.3	1…5	Weighted average of scores from "buildings" energy economy KPIs (Benchmarking Methodology)
Overall Energy Efficiency & Economy KPI				
43*	E_EF B KPI	3.3	1…5	Weighted average of scores from Energy Efficiency KPIs (Benchmarking Methodology)
44*	E_EC B KPI	3.3	1…5	Weighted average of scores from Energy Economy KPIs (Benchmarking Methodology)
SUSTAINABILITY				

45	(Eren-el+Eren-th+Eren-mob)/Etot	19.07	%	Ratio between total renewable energy consumption and total energy consumption (electricity from grid and district heating are considered 100% renewable)
46	CO2/Etot	0.221	tCO2/MWh	Tons of CO2 emitted per MWh of energy consumption
47	SM KPI	2.3	1…5	Weighted average of scores from the Sustainable Mobility section
48*	ES KPI	3.3	1…5	Weighted average of scores from Sustainability KPIs (Benchmarking Methodology)
ENERGY MANAGEMENT				
49	EM KPI	3.5	1…5	Weighted average of scores from the Energy Management section
SMART GRID				
50	SG KPI	2.3	1…5	Weighted average of scores from the Smart Grid section
ADAPTATION TO CLIMATE CHANGE				
51	ACC KPI	4.0	1…5	Weighted average of scores from the Adaptation to Climate Change section
SELF EVALUATION				
52	SE KPI	3.4	1…5	Weighted average of scores from the Self Evaluation section
FUTURE OUTLOOK				
53	FO KPI	4.0	1…5	Weighted average of scores from the Future Outlook section
OVERALL RESULT				
54*	OV KPI	3.4	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

Table 3 : List of evaluated KPIs for each ski resort (in the "value" column the average of the three living labs)

5. KPI results analysis

5.1. Wi-EMT Evaluation Report

The Wi-EMT Evaluation Report includes the ski resort ID and the ski resort KPIs.

In this way it provides an overview of the level of energy efficiency, sustainability and management in the ski resort and compares its performance with an Alpine Space reference. Beside an overview and a comparison of the performance, the report provides a database for further measurements of improvement, which will strengthen the international competitiveness.

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's performance is among the the worst and KPI = 5 means that the ski resort's performance is among the best compared to the other involved ski resorts (Figure 2).

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.

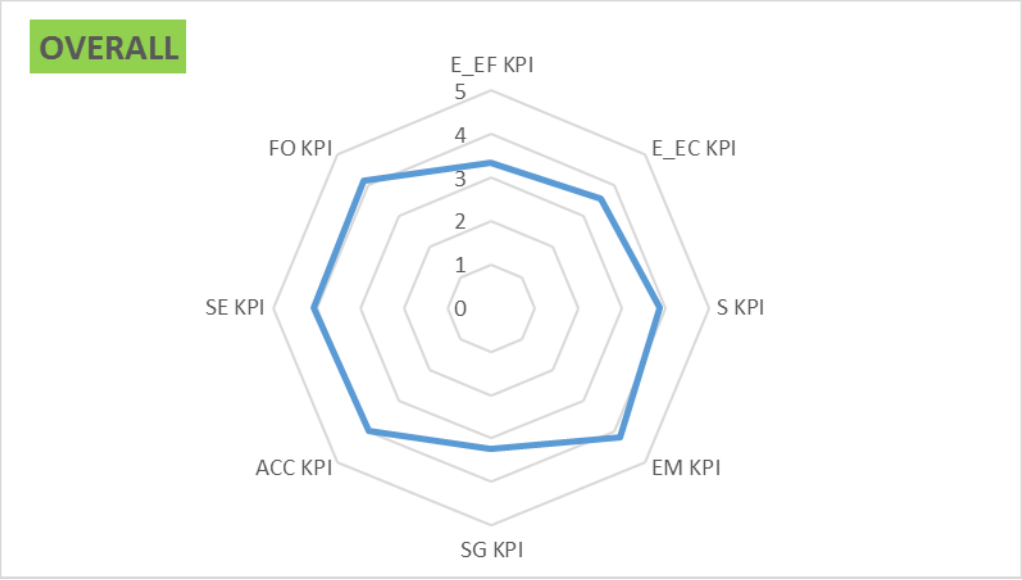

Figure 2 : Example of an overall analysis of a ski resort

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

5.2. Integrated Energy Management System

Key Performance Indicators issued from the Wi-EMT are based on average annual data. On the other hand, some KPIs can be considered in real-time, within an Integrated Energy Management System, if the collected data allows. These real-time indicators could therefore be used for daily management of ski resort infrastructures.

Each ski resort can select from this KPIs listing the most relevant ones for its daily operations. The following KPIs are regularly used by Energy Management Systems in a ski resort (Table 4).

KPI COD	KPI CALCULATION	UNIT	DESCRIPTION
ENERGY EFFICIENCY & ECONOMY			
Snow production			
15	EelSP/VSP	kWh/m3	Electricity consumption for snow production per m3 of produced snow
Ski-lift			
19	EelSL/(TD)	kWh/km	Electricity consumption for ski lifts per km of drop
21	EelSL/(NE)	kWh/E	Electricity consumption for ski lifts per entrance
Snow groomers			
27	ESG/(TS)	kWh/km2	Energy consumption for snow groomers per km2 of treated slope
29	ESG/(GD)	kWh/km	Energy consumption for snow groomers per km of drop
Buildings			
35	EHB/(BS)	kWh/m2	Heating consumption for buildings per m2 of building surface
37	EEB/(BS)	kWh/m2	Electrical consumption for buildings per m2 of building surface
SUSTAINABILITY			
45	(Eren-el+Eren-th+Eren-mob)/Etot	%	Ratio between total renewable energy consumption and total energy consumption
46	CO2/Etot	tCO2/MWh	Tons of CO2 emitted per MWh of energy consumption

Table 4 : List of KPIs that could be integrated into an Energy Management System

The set of “real-time” indicators presented in Table 4 are indicators based on energy consumption (in kWh). In reality, it would be more interesting to access the final power consumption (in kW) for each system. Therefore, a real-time energy management could be possible.

For instance, some KPIs have been integrated into the Smart Altitude Energy Management System realized for the living lab of Madonna di Campiglio (Figure 3). This KPIs selection is slightly different from Table 4 since it is based on skier-day. Nevertheless, the conclusions for a daily operation are the same.

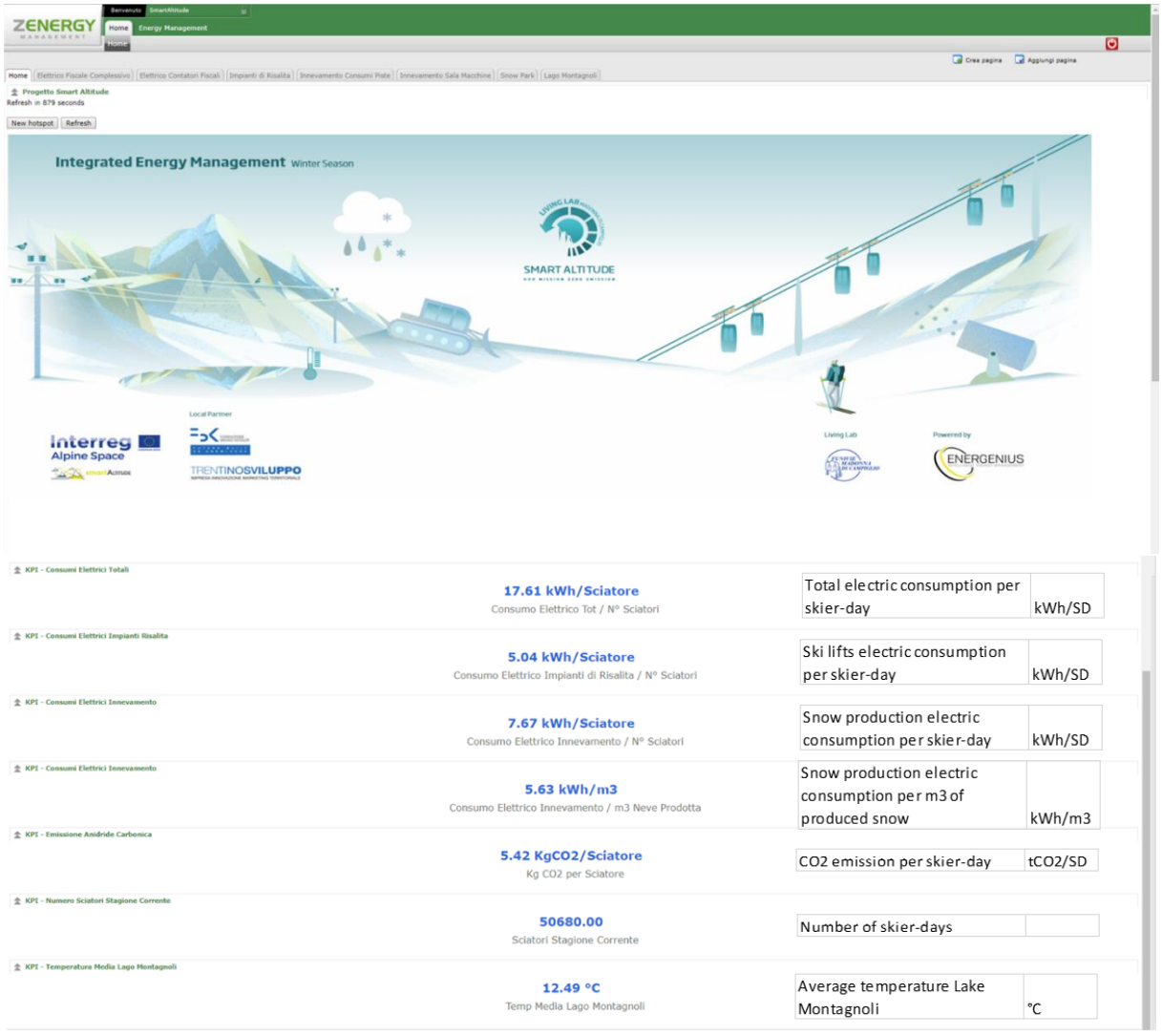

Figure 3 : Seasonal KPIs considered in real-time within the Smart Altitude IEMS of the Living Lab Madonna di Campiglio (preliminary version December 2019)

5.3. WebGIS & WIKIAlps integration

All the individual data set collected to assess the KPIs are private data. They cannot therefore be publicly displayed.

However, involving an adequate number of ski resorts, it is possible to identify some average KPIs at national and Alpine Space level that can be integrated into the WebGIS (Figure 5). Moreover, background information on the KPIs will be available in WIKIAlps.

Until now, the analysis is limited to the 3 living labs of the Smart Altitude project. Nevertheless, the goal is to involve 20 other ski resorts in order to obtain a statistical basis at the moment unexplored. Therefore, at the end of the project, average public KPIs will be evaluated from at least 23 ski resorts.

The public average KPIs are shown in Table 5.

KPI COD	KPI CALCULATION	UNIT	DESCRIPTION
Overall Energy Efficiency & Economy KPI			
43*	E_EF KPI	1…5	Weighted average of scores from Energy Efficiency KPIs (Benchmarking Methodology)
44*	E_EC KPI	1…5	Weighted average of scores from Energy Economy KPIs (Benchmarking Methodology)
SUSTAINABILITY			
48*	S 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

Table 5 : KPIs listing for a public use

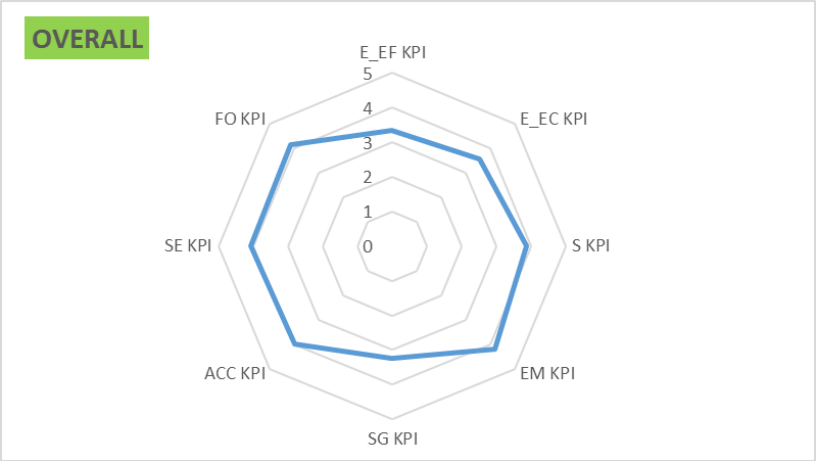

Figure 4 : Public overall analysis of a ski resort

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

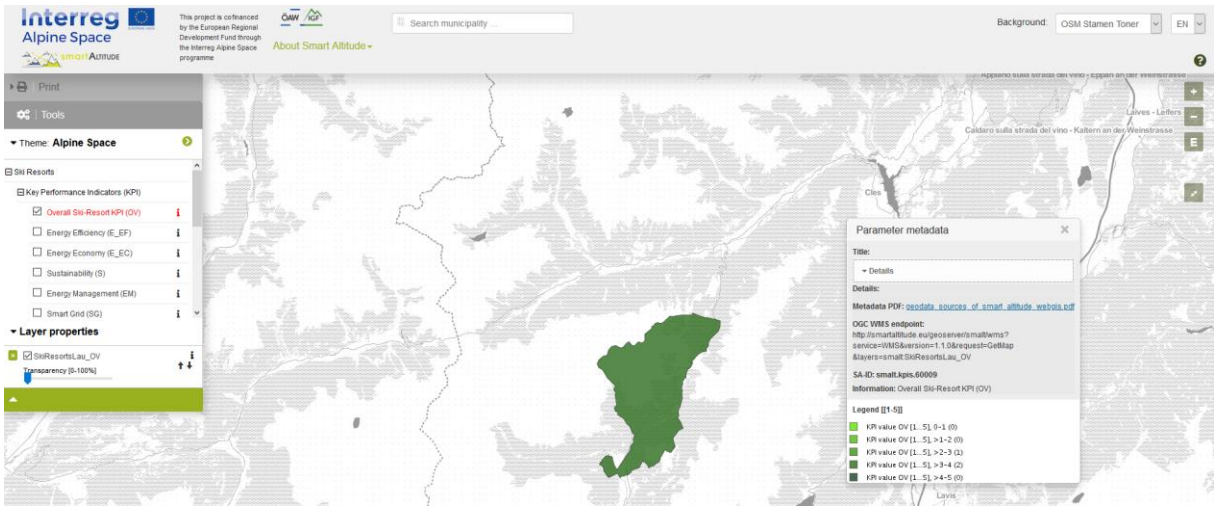

Figure 5 : Screenshot of the Smart Altitude WebGIS showing the overall KPIs for Madonna di Campiglio living lab

6. Conclusion

Activity A.T1.3 allowed to identify 54 Key Performance Indicators divided into 9 main sections (Energy Efficiency, Energy Economy, Sustainability, Energy Management, Smart Grid, Adaptation to Climate Change, Self Evaluation, Future Outlook, Overall Result).

These KPIs are defined on the basis of data collected through a questionnaire for ski resort operators.

An evaluation report is then provided to the involved ski resort operators. Thanks to this tool, ski resort operators can carry out a rapid diagnosis to prioritize low-carbon measures.

Some KPIs can be transformed into real-time indicators for Integrated Energy Management Systems used for the daily energy management of ski resorts. The living lab of Madonna di Campiglio represents an application case of the use of these KPIs.

Finally, involving an adequate number of ski resorts it is possible to identify some average KPIs at national and Alpine Space level that can be published on public platforms such as the Smart Altitude WebGIS.

This methodology has already been applied to the 3 living labs and will be replicated on 20 other ski resorts. The goal of these 20 replication is not only to produce average public indicators but also to have a better knowledge for low-carbon measures prioritization at the Alpine Space level.

This activity was a key stage in the life of the Smart Altitude project. In facts, it serves as a basis for energy and environmental performance assessment of a ski resort. All the results of this activity will therefore be used by the other Smart Altitude activities to prioritize low-carbon measures.

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