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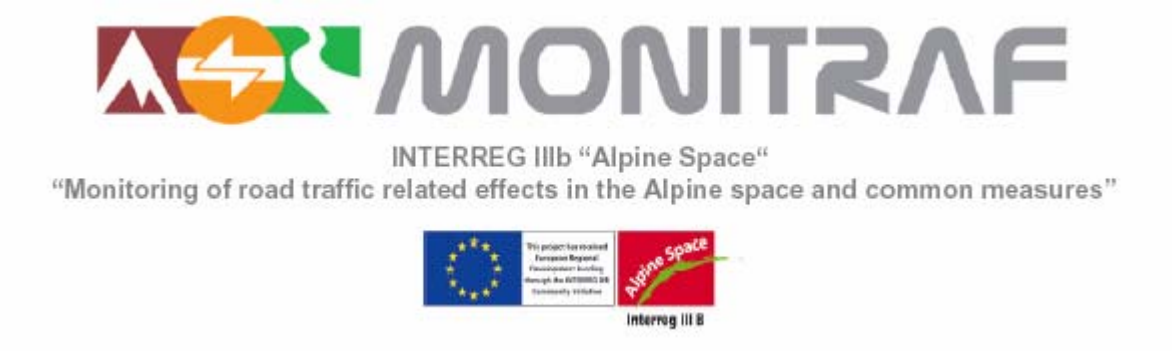
MONITRAF – WP7

Indicators: selection, definition and harmonization

The system of the MONITRAF indicators



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Abstract

Even in the Alpine regions, the good functioning of daily the life and of the economy depends on an efficient transportation system. But the huge growth of road traffic in the last years has caused, and is still causing, considerable social effects (inequity, effects on human's health, difficult cohesion of the community, etc.), environmental impacts (greenhouse gases, air pollution, noise, lost of habitat, etc.) and also detrimental effects on the economy itself (traffic congestion, mobility's barriers, accidents, services costs, etc.).

For these reasons, on the political side people are doing big efforts along the main Alpine crossing corridors to reduce the negative impacts. In particular they are encouraging means of transport that are more compatible with the environmental system and are trying to apply the concept of "sustainable mobility" to the transport management. Sustainability is not so easy to measure because its definition not directly imply methodologies or indications of instrument for its univocal and scientific evaluation.

One way to understand the territorial and social systems can be the use of indicators, which represent one useful instrument to help to understand the condition of a system within its evolution and to take more efficient and comprehensive decisions. In order to develop an analysis based on a monitoring system via indicators it is necessary to fix a set of criteria to identify and develop the suitable indicators in relation to the purposes of analysis: the efficient use of indicators can actually occur only inside a technical and conceptual procedure fixed in advance. In particular, a good technical and conceptual procedure necessary to create the conditions of an analysis using suitable and efficient indicators, should be based on a set of criteria to organize taxonomically the indicators according to a *framework* a set of criteria for the selection of indicators as well as a set of methods for the evaluation of the strategies and applied after the results of the analysis carried out with the help of the indicators.

In the present study a list of criteria to select the indicators will be presented as well as a presentation of the most important international *frameworks,* used for the correct choice of the indicators for the analysis and evaluation. The most important and most

authoritative references are international institutions like OECD, UN and EEA. The leading scheme used for the presentation of indicators in this study was derived form the analysis of different experiences done in several contexts with different purposes and it makes itself clear in a predisposition of a structure of an indicators' system created on purpose of the goals of the MONITRAF project.

In order to achieve this goal, it has been created a list of 10 key questions strictly referred to the purposes of the MONITRAF project. The analysis of these key questions allows a discussion about the content of the different analysed lists of indicators and equally the research of more indicators that could be of interest referring to the basic purposes of the project, which results are in fact the produced and presented list. For a further development of the proposed indicators it is suggested a division after the specific goals of the MONITRAF project.

In particular, the indicators defined as **"core"** are the indicators which allow us to give a picture of the main thematic spheres to the politicians, responsible of the decision process and for the public discussion. Through them it is possible to trace the involved factors and the possible improvements in the economic, environmental and social performances. We must then understand the **"key"** indicators as a limited group of indicators, obtainable from the group of indicators "core", which are of particular interest and which respond to wider communication purposes and are of particular importance for the intent to give clear and immediate information also to the public opinion. In the procedure a motivated selection of "core" indicators will be presented, which has been deduced comparing the different proposals, stemming from the partners of the project on the base of the analysis of the presented charts. A selection of "key" indicators, where the preceding result is particularly "labeled" referring to the MONITRAF project. We have also analysed the different sources, originating from different experiences on several levels: national, international and community, indicating, even if not in all cases, many indicators, often adapted to the analysis of the transport sector or to the application in the specific alpine territory.

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1 Introduction

1.1 The sustainability: a new integrated paradigm

In the last ten years the concept of sustainability imposed itself as an emerging paradigm in the development politics, as it was already intuitable from the definition given in occasion of the United Nations Conference on Environment and Development (UNCED) in 1987, in Tokyo:

> «*sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs*» [WCED, 1987]

Its main characteristic, particularly in case of its application in a non-natural, artificial environment, like cities or infrastructural nets, consists in its integrated and integrative nature.
The development plans and the planning process have to take into consideration sustainability in a way that will ensure the preservation of the territorial resources recognized as unique and not replaceable, and have to take care that every physical transformation of the territory will be oriented to a compensation of territorial resources not only in environmental, but also in social and economic terms.
The different disciplinary fields that constitute the economic, social and environmental sciences have to communicate and compare themselves according to the different research sectors.
sustainability can be subdivided into the different dimensions that characterize it:

- *the institutional dimension of sustainability*, which involves governmental and non-governmental organizations that carry direct and indirect responsibilities in the development management producing plans and regulations. The main assumption on the *institutional sustainability* is that there is a direct connection

between the growth of the local society and of the democratic institutions and the increase of negotiating capacities. The existence of this dimension is a security for the respect of democracy itself and a way to reinforce it;

- *the social dimension of sustainability*, which requires that the system of public and private actors that negotiate the development goals is complex enough to ensure the presence of the weaker social actors and of their problems, so that it will also be able to incentivate the identification, proposal and the making responsible of these problems. That is why the most profound expressions of local self-sustainable development base their goals, and their consequent actions, on the promotion of making responsible, of a *local empowerment*, that is able to rebalance the relation among the powers (of information, economic and political) and is able to ensure its fundamental status of subjects' "legitimacy" to the communication and participation;

- *the economic dimension of sustainability*, which claims the overcoming of a vision of the economic compatibility according to purely quantifiable parameters, in order to talk about a sustainable economic development according to "integrated indicators" that will make evident the overcoming of monocultural conceptions towards complex economies. Economies, more and more immaterial and based on access and sociality, impose their presence in the future modeling process requiring planning process attention and respect meaning cooperation;

- *the environmental dimension of sustainability*, which requires a commitment to integrated projects that will assure an anthropocentric vision. The aim of this vision will be to look for the environmental boundaries within which it will be possible to maintain a certain model of economic development. It emerges then the necessity to reduce pressure on the physical environment, according to the boundaries of the system, like for example, through the drawing of the environmental systems and of the conditions of their self-reproduction as ordering principle of the settlement system.

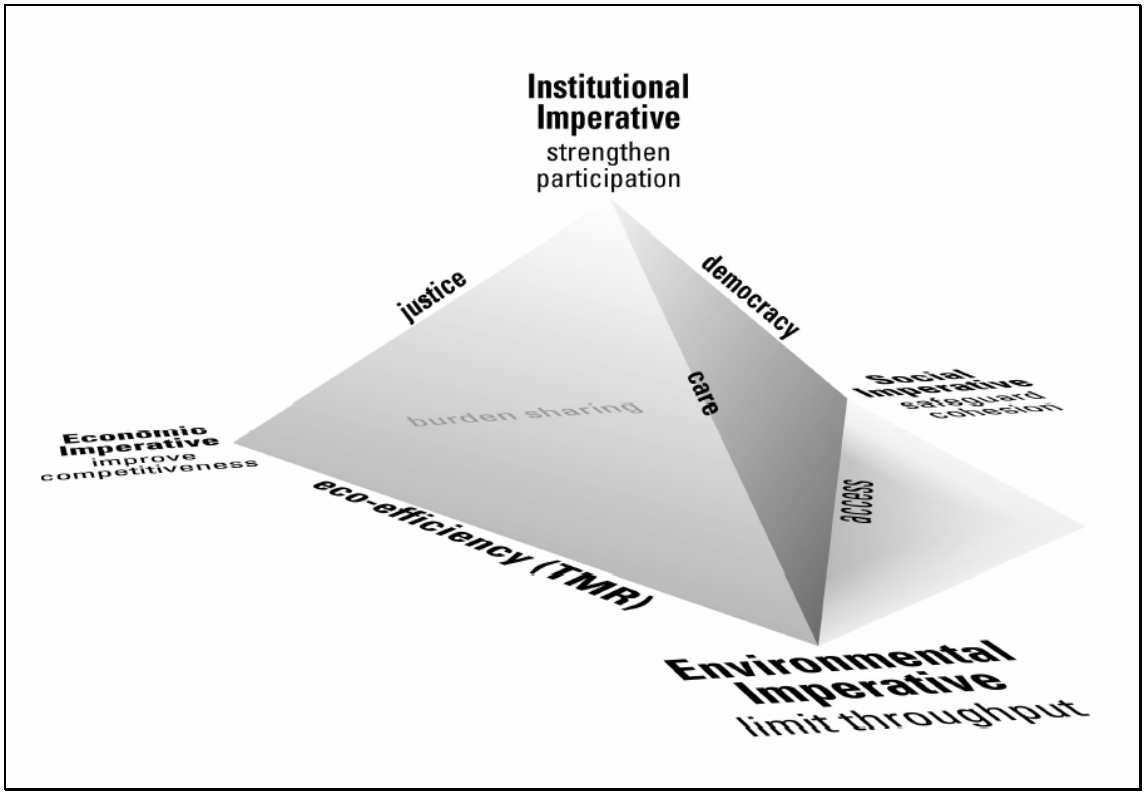


Figure1–The prism of sustainability after Spangenberg.[1]

Source: Spangenberg, J. H. and Lorek, S. (2004). "Sustainable Consumption SERI's transdisciplinary research approach", Sustainable Consumption WS, Tokyo, October 20th-22th, 2004, http://www.seri.at/Data/personendaten/js/SyL04-1015SCTokyorev.pdf, visited 02/2006.

What has just been outlined here, constitutes the conceptual base of this study.

1.2 Transport and sustainable development

The evolution of infrastructures and transport is strictly bound to the economic development. The goods transported across the Alps are also constituted an important source of income for the local populations and nowadays still represents an important growth factor for the economy.

[1]According to this figure, the four dimensions of sustainability are: the individual dimension (social system, human capital), the social dimension (istitutional system, social capital), the economic dimension (economic system, "man made" capital) and the environmental dimension (natural system, environmental capital).

In the Alpine regions, the good functioning of daily life and of the economy depends on an efficient transport system. But the huge growth of road traffic in the last years has caused, and is still causing, considerable social effects (inequity, effects on human's health, difficult cohesion of the community, etc.), environmental effects (greenhouse gases, air pollution, noise, lost of habitat, etc.) and also detrimental impacts on the economy itself (traffic congestion, mobility's barriers, accidents, services' costs, etc.).

For these reasons, on the political side people are doing big efforts along the main Alps crossing corridors to reduce the negative impacts. In particular they're encouraging means of transport that are more suitable to the environmental system.

Historically, since the '90s, when after the Conference in Rio '92 people began stimulating a communication process aimed to know the environmental condition and the impact of some decisions, they tried to apply the theory of sustainability to the transport policy too, creating in this way the concept of "sustainable mobility".

From the most common definition of sustainable development we can then derive some general principles, that include the aspects relative to the three "classic" dimensions of sustainability (economic, environmental and social, which are functionally related to the institutional dimension) and that, for example, can be made clear in relation to the necessity of preserving the public health and the environmental quality, to the necessity of using resources in a sustainable way, to the necessity of respecting the critical threshold values for health and ecosystems and to avoid irreversible global effects.

In general, a sustainable transport system should possibly try to satisfy the following requirements:

- to allow a safe access, economically feasible and socially acceptable to persons, places, goods and services;

- satisfy the needs of different categories inside the society and for different generations;

- being projected in a way compatible with the health and safety of the population;

- using renewable resources at a lower level than their regeneration rate and the non-renewable resources at a lower level respect the develop rate of a renewable substitute;

- reach the goals generally accepted for the environmental health and quality;

- protect the ecosystems avoiding the overcoming of critical loads and level of their integrity;

- do not worsen the adverse global phenomena, like for example the climate change;

- promote the education and participation of the community in the decisions about transport and mobility;

- involve experts of the environmental, health, energy and city planning sectors in a process of integrated planning;

- allow an efficient use of the territory and of the natural resources;

- support the economic wealth;

- prefer the total capacity of the system instead of the top performances of some of its components, and prefer the efficiency and regularity to the maximum speed;

- bring back mobility to its true role aiming at the accessibility, which can also be satisfied by interventions in sectors like for example the technological innovation and urban and territorial planning.

[Contaldi, Pignatelli, 2005, p. 6]

That is why planning the transport system in a sustainable way means to take into account the interactions between the different problems so that we will be able to give integrated solutions able to follow multiple purposes to the politicians. This is particularly true in the Alpine area, where we should reach a condition where the different specificnesses melted in an identity defined by supranational characteristics, considering the strategic importance of the Alps for the neighbour regions due to the historical crossings and important ways of communications.

2 Sustainability and indicators

Sustainability is not so easy to measure because there are not any methodologies or indications of instrument directly developed for its univocal and scientific evaluation.
One way to understand the territorial and social systems is the use of indicators, which represent one useful instrument to help the knowledge of the condition of one system and to help taking more efficient and complete decisions. A great quantity of environmental indicators already exists and a great deal of progress has been made in the definition of methodologies aimed to identify them, even if not all the environmental indicators can be used as indicators of sustainability.
In particular, to measure the level of environmental sustainability of the transport system, it is necessary to use proper indicators.

2.1 Definition of indicators

In general terms, an indicator can be defined as:

> *…a parameter, or a value derived from parameters, that gives information about, describes the state of a phenomenon /environment/ area, with a meaning that goes further than what is directly associated with the parameter value* [free translation from OECD, 2003]

> «*An indicator quantifies and simplifies phenomena and helps us understand complex realities. Indicators are aggregates of raw and processed data but they can be further aggregated to form complex indices. Whether an indicator is useful or not depends very much on the context.*» [International Institute for Sustainable Development, in Pileri, 2000, p. 47]

> *«"You can't manage what you can't measure". The success of current and future integrated policies can only be judged by identifying key indicators that can be tracked and compared with concrete policy objectives (benchmarking).»* [Jiménez-Beltrán, 2000]

It is necessary to underline that it does not exist an "ideal indicator" but instead a series of "ideal criteria" able to assure the technical selection and the development of a good indicator.

2.2 Indicators and the policy-cycle

If we do accept the theory according to which the indicators can be very useful in both the field of scientific observation and in the one of policy evaluation, then it is

necessary to specify how indicators can be inserted into the policy-cycle in the most effective way.

In this study we will refer to the policy-cycle of Winsemius[2], which is nowadays widely accepted by several international organizations.[3]

This analysis allows us to understand how and in which way the data and their analysis through the indicators can be inserted into a decisional process expressed by a policy-cycle.

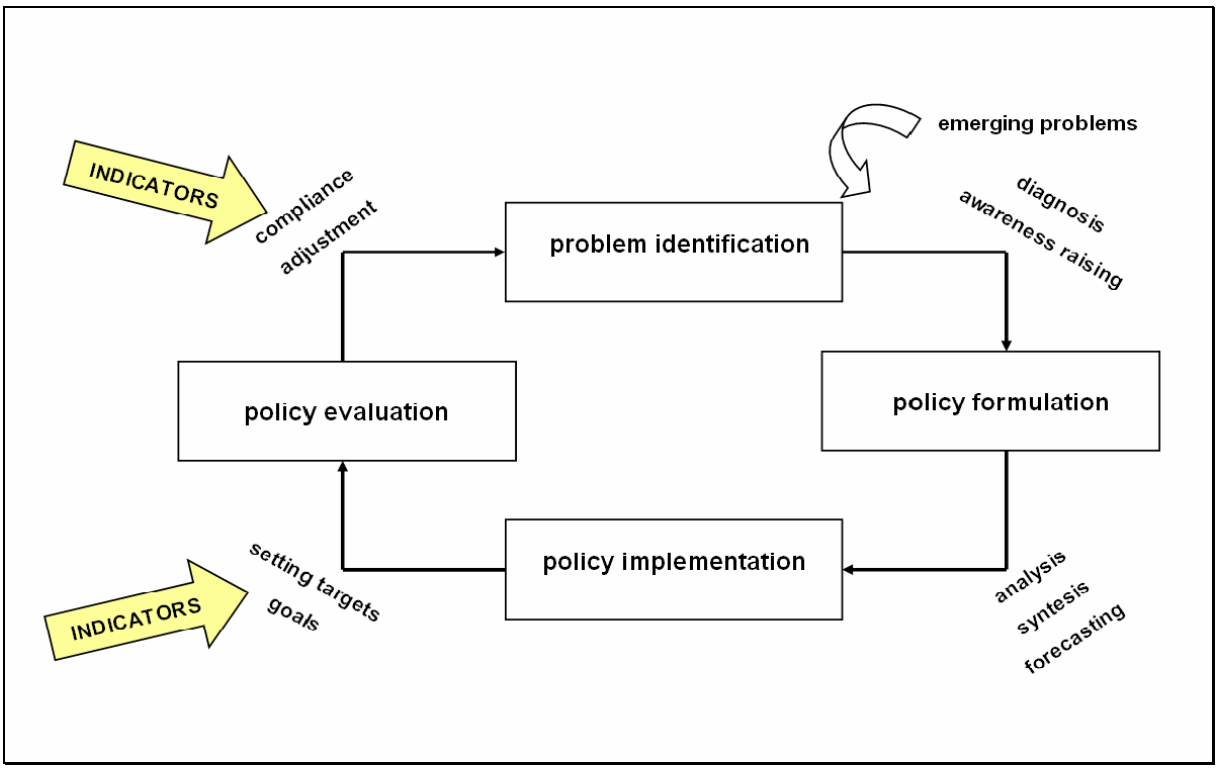


Figure2–The policy-cycle of Winsemius.

Source: [Winsemius, 1986, elaboration IRE].

According to Winsemius, the decisional process can be essentially articulated in four phases:

[2] [Winsemius, 1986].

[3]For example from the EEA:
http://bpr.dmu.dk/2thematicrep/obligations/eea_opgoerelse/policyIndicators
or from the FAO: http://www.fao.org/docrep/W4745E/w4745e07.htm, visited 07/2006.

- problem identification;
- policy formulation;
- policy implementation;
- policy evaluation.

The preliminary analysis activities aimed to highlighting the preconditions and necessary to distinguish the problems by their characteristics and peculiarity are concentrated in the **problem identification** phase.

In this phase the problem inserted in a framework and the different connections between the economic, social and environmental aspects are studied. The participation of scientific specialists results essential but we also need a more collaborative participation by various stakeholders to better examine the different aspects.

In the **policy formulation** phase, the policy makers elaborate strategies, based on the work done in the preceding phase with the aim of giving an answer that tend to be resolutive to the problem. In this phase one can better identify the goals, defined in a general way in the preceding phase, and create a project containing actions, interventions, schedules and phases, which will support the strategic policy.

The phase of **policy implementation** consists in the application of what has been decided on the paper, through a series of interventions and concrete measures. It is important to support this phase with a program that identifies the necessary resources or the right operations needed to carry out the measures, which will make possible the satisfaction of the goals identified in the initial phase of the process.

It is also very important to note how the definition of the goals, connected to the precise identification of the needs, has a very important and priority role in respect of any choice of indicators.

The conclusive phase of the **policy evaluation** aims to value the adopted policy strategies from the point of view of the performances or, in other words, to control the achievement of the goals.

The following chart can well explain a possible correspondence between the policy-cycle phases and the necessary data/indicators. This chart shows also how the indicators are constantly necessary in a ongoing process of improvement of the reaction abilities to different demands of the society.

Table1 – Analysis of the different indicators in relation to the policy-cycle phases.

Source: [Pileri, 2002, elaboration IRE].

Policy-cycle phase	Indicator's requirements
Problem identification	Able to point out the compromised situations, to give answers in short times and to show middle-long term trend
Policy formulation	To be able to make an evaluation and a prevision of the cost/benefit for different policy options
Policy implementation and evaluation	To be able to make a comparison between the current situation and a situation identified by a target

Obviously this is a topic that requires deep study and that lies outside the purposes of this work package. At this point we suggest more comprehensive debates and publications.

2.3 Good practices for the selection of indicators

Once defined the conceptual references in relation to the sustainable development and once taken conscience of the necessity to develop an analysis based on a system of monitoring through indicators, it is necessary to fix a series of criteria to identify and develop the correct indicators according to the purposes of the analysis.
The effective use of indicators can only occur inside a technical frame that has to be clearly prefixed in advance. It is necessary to point out that, even if it is not possible to identify in an univoque and definite manner the "ideal indicator", it is correct and wise to identify the "ideal criteria" that will assure the technical selection and/or the right development of an indicator.
In particular, a good technical and conceptual procedure necessary to create the condition of an analysis through the suitable and efficient use of indicators, should forecast a set of criteria to organize taxonomically the indicators after a *framework* of reference that is reusable and reproducible, a set of criteria for the selection itself of indicators and also a set of methods for the evaluation of the strategies formulated and applied after the results obtained by the analysis based on the indicators.

Accordingly a scheme to project/choose the indicators involves a balance between three basic needs:

- scientific exactitude and validity;
- political acceptability and effectiveness in relation to the defined goals;
- technical feasibility, that have also to include the costs for the gathering of the data.

In particular, referring to what has been exposed so far, we want to go back to the important question of the identification of the selection criteria of indicators.
It is difficult to choose an indicator; it is also difficult to understand which is the right number of indicators to obtain an exhaustive description of the phenomenon that one wants to analyse without falling in the trap of accumulating an enormous quantity of data that, instead of improving the outcoming of the final decisions, will provoke an overflow that confuses and paralyses the decision-making process.
A first answer to these problems can come from the analysis of the lists proposed in the literature by the main international organizations (UN[4], OECD[5], EEA[6]) or by the most reputated research institutes (SERI[7], IISD[8] , Wuppertal Inst.[9] ,ESL-JRC [10]...) that in the last years have carried indicators-based evaluations.
A careful analysis of the lists permits to highlight a path useful to the selection or design of indicators (about the frameworks mentioned in the following tables, please refer to the following chapter 3).

The following table presents an example of a indicator list. In the English version of the final report the indicator list is limited to this example. In the original Italian Version further examples very included.

[4] http://www.un.org/esa/sustdev/index.html.

[5] http://www.oecd.org.

[6] http://www.eea.europa.eu/.

[7] http://www.seri.at/.

[8] http://www.iisd.org/.

[9] http://www.wupperinst.org/.

[10] http://esl.jrc.it/.

Table 2 –Indicators divided into categories, as reported in the OECD document of 1993 (S mean "short term indicators", M "medium term indicators" and D "long term indicators").

Source: [Pileri, 2002].

Environmental	Pressure	State	Response
Climate change	Emissions of CO_2 (S),CH_4 (S/M) Consumption of CFCs (S/M), emissions of N_20	Atmospheric concentration of greenhouse gases (S), global mean temperature (S)	Energy efficiency (M/D), energy intensity (S), expenditure on efficiency, alternative energies, research (M)
Ozone layer	Consumption of substances dangerous for the ozone (M), consumption of CFC (S)	Concentrations in the atmosphere (M), UV-B radiation on the ground (M), ozone levels over selected areas (S/M)	Expenditures on replacement technologies (D), contribution to the Interim Fund associated with the Montreal Protocol (M)
Eutrophication	Emissions of N and P into water and soil (D), consumption of fertilizers measured with N and P(S), waste water discharges (S/M), livestock density (S/M)	Concentration of P and N in inland (S/M) and marine waters (M/D)	% of the population connected to waste water treatment (S), rate of the waters' treatment (M), % of the market for detergents without phosphates (S/M)
Acidification	Emissions of SO and NO (S), ammonia (M)	Exceedence of the critical loads of potential acid in water and soil (S/M), concentration in acid precipitations (pH, SO, NO), (M)	% of the cars equipped with catalytic converters (S/M), capacity of Sox and Nox abetment equipment of stationary sources(M/D), Nox of
Toxic contamination	Emissions of heavy metals(M/D), emissions of organic compounds (D), consumption of Pb, Hg, Cd, Ni (S/M), consumption of persticides (S/M), generation of hazardous waste	Concentration of heavy metals and organic compounds in environmental media and living spaces (D), concentration of lead, cadmium, chromium, copper in rivers (S/M)	Changes of toxic contents in products and production processes (D), rehabilitated areas as % of total areas identified as contaminated, market share of unleaded petrol (S)
Urban environmental quality	Urban air emissions: SOx, NOx, VOC (M), traffic density (S/M), degree of urbanisation (S/M)	Exposure of the population to air pollutants (S), cancer (M), ambient water in urban areas (M)	Changes in green spaces as a % of total urban area (M/D), regulations on emissions and noise levels for new cars (S/M), expenditure on water treatment and noise abatement (S)
Biological diversity and landscape	Habitat alteration and conversion of land from its natural state (D), land use changes (S) introduction of new genetic material and species(D)	Threatened or extinct species as a share of known species (S)	Protected areas as a % of total area (S) by ecosystem type (D), protected species as a percentage of threatened species (M/D) waste minimisation efforts (D)
Waste	Municipal waste (S), industrial waste (S), toxic wastes(S)		Charges for waste disposal (M), expenditure on waste collection and treatment (S), waste recycling and recovery rates (S)
Water resources	Intensity of use of water resources (S), % of discharged waste waters in rivers (M/D)	Frequency, duration and extent of water shortages (M)	Water prices and user charges for waste water treatment as % of cost (M)
Forest resources	Short-run sustained yield/actual harvest (S/M)	Area/volume and distribution of forests (S), % of disturbed/deteriorated forest in total forest area (M/D)	% of harvest area successfully regenerated or afforested (M/D), % of protected forests area in total forest area
Fish resource	Fish catches (S)	Size of spawning stocks (M), overfished areas (M/D)	Number of stocks regulated by quotes (M), expenditure for fish stock monitoring (M/D)
Soil degradation	Erosion risk: potential and actual use of soil for agriculture (D), land use changes (S)	Degree of top soil losses (M)	Rehabilitated areas (M/D)
Economy, society, general indicators not attributable to specific issues	Population growth and density (S), GDP growth (S), industrial production (S), energy supply (S), structure of energy supply (S), road traffic volumes (S), road vehicle stock (S), agricultural production(S)		Environmental expenditure (M) and for environmental training (S), pollution abatement and control expenditure (S)

Futher indicator lists were produce by UN in the context of the Agenda 21 (see http://www.un.org./esa/sustdev) or the European Environmental Agency (see http://themes.eea.europa.eu/indicators/all_indicators_box)

The present study begins with a list of criteria to select the indicators obtainable from the analysis of the lists above [11]and also a presentation of the most important [12]frameworks of selection useful to the correct choice of the indicators for the analysis and evaluation.

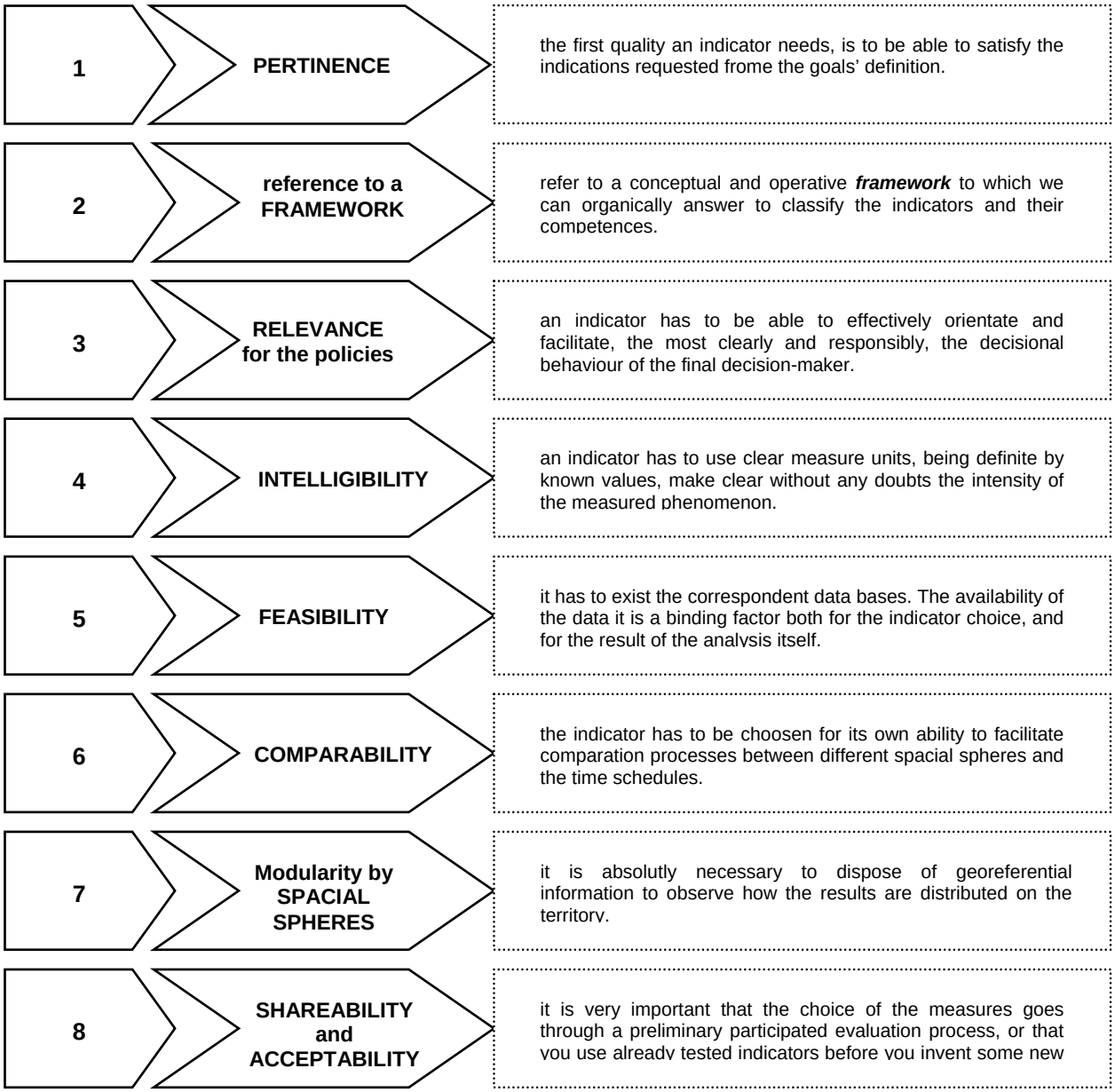


Figure 3 –The list of criteria for the selection of indicators.

[11] *See Pileri (2002), p. 54.*

[12] *See Pileri (2002), pp. 55-57.*

Source: [Pileri, 2002, elaboration IRE].

An obvious but extremely important consideration is the one that the final results of an analysis conducted through indicators will be affected by the methods and care with which the selection and identification process of indicators is built.
We would like to highlight that in this case as final results are intended both:

- the merit results; about the pure value expressed by the indicator and, more generally, by the analysis;
- process results; about the analysis, also after the decision-making, of the implemented actions for the achievement of a particular result.

We show here both the control of the phenomena and the control of the processes managing the phenomena and of the political instruments that determinate and regulate them as two inseparable parts of the global results of an analysis through indicators.

2.4 The geographical scale of reference for the analysis through indicators

Another aspect we have to consider for the indicators selection is the territorial range of reference of the analysis' goals that has to take into consideration the spatial scales in conformity with the data that can be collected.
In some cases, the choice will have to be driven from political competence criteria but, when the subject of the policies we want to implement does not find a formal correspondence and requests evaluations that can not be limited to the administrative boundaries we will have to propose indicators that "overcome" them.
In other cases, the minimal territorial dimension of reference will be driven from pure research purposes and only later recomposed in correspondence with the action range of the policies/directions that will be proposed.

Other choice criteria can be driven from the needs of the data georeferentiation or from the needs for an efficient management of big data quantities not perfectly accordant.
In short, we will have to take into consideration the needs about the formal spheres of competence, the needs about the choice of spatial ranges in function to the subjects of the analysis and the needs about the practical management of data bases where the indicators will have to be saved.

So we will be able to elaborate the choice criteria in relation to the geographical scale of reference, taking into consideration:

- the competence and goals of the considerated policies;
- the needs of the analysis and georeferentiation;
- the needs about the characteristics of the subject dealt;
- the problem of the data availability;
- the significancy of the measures in correspondence with the space spheres.

Obviously we will have to carry out some operations to mediate the choice so that the analysis will not tend too much on one side or the other, depending on the considerated aspects.

2.5 The functional classification of indicators

The indicators usually condensate information stemming from the so called unprocessed data (i.e. results coming from answers to questionnaires) as well as from the processed ones.
It is possible to create different categories of indicators based on the purpose or action area of the indicator itself.
We propose here four different categories of indicators:

- *descriptive or presumptive indicators*. These are normally indicators about very common measures that are usually presented in the form of ratios or sums derived from simple measurement or from unprocessed and/or partially processed data (the algorithm of such indicators has an extremely simple mathematical form). Usually, the information we can derive from these indicators are only useful to the construction of the reference picture, and do not give any compound or strategic information and usually do not mix data and measures from different fields (i.e. measurement of environmental phenomena with measurement of social or economic phenomena).
  Example: consistency of the road network [km_{roads}/km $Sq_{cosideredarea}$], fragmentation degree [perimeter of an area/surface of an area];

- *indicators of performance*. These are indicators quite similar to the descriptive ones but have a threshold value to which we can refer the carried-out measure. This make it possible to do a comparison with respect to the limit conditions expressed by the defined threshold.
  The thresholds or limit values can be of nature:

  - conventional; more subjects reach an agreement and fix a value that cannot be exceeded and that will have some characteristics of quality or normality, which represent the goal of the decision-making process;
  - natural; in this case is the nature itself that sets some limits (exhaustion of resources, biological limits above or beneath which some dangerous situations would start, geomophologic limitations about limit slopes, etc.). The limits has to be identified, formalized and made available through a special study;
  - regulating; the limits are established from analysis-based laws or rules, studies and validations. If the thresholds are exceeded, there will be administrative regulations. Generally speaking, thresholds are the result of policy choices to respect some particular goals. This category of indicators is adapt for the policies formulation, for the

subsequent implementation and for the necessary evaluation, that is for the measure of the effectiveness degree of the decision.
Example: water supply [l/inhab*day], agricultural soil exploitation expressed by the used agricultural surface – UAS [km Sq_{UAS}];

- statistic; the limits are of statistic nature, they are obtained with the application of some statistic tools and can help the analyst in making some comparisons;
- comparative; the comparative analysis allows us to obtain limits by creating a classification obtainable in reference to the decided goals. First we order the cases according to the numeric value of the indicator. This allows us to measure the response abilities of the cases to the goal to reach. All other cases are ordered in consequence after a classification based on the smaller distance from the best performance (that has not necessarily reached the goal value). We can then take as reference the value associated to the best answer, which is the same with the best relative position. The comparative analysis is particularly useful in the policies evaluation phase;

- *indicators of environmental efficiency.* These are in general descriptive indicators that highlight the report between a measured phenomenon (CO_2 emissions, soil consumption) in relation with measures that identify the welfare of the subject (GDP, consumption, …) or with the connected anthropic activities (number of sold vehicles);

- *statistic indicators.* These are measures coming from statistic algorithms that become measures of control themselves. They are indicators that represent a trend or a course of phenomena both on the time axes and on the space axes of the analysis.

If we make an aggregation of two or more indicators we obtain a new measure called index, that is a measure having a high information level and that configures itself as a qualitative measure of great impact and communicative power.

It is always necessary to match every index with the matrix of the indicators where the index comes from the understanding of the weight exercised by the measures of the single components. The indexes can also be obtained through complex algorithms that mix different indicators or through complex aggregation systems based mathematic or statistic models.

2.6 What are/not are indicators for

It is necessary to underline from the beginning of this study, also referring to the presentation done in the previous paragraph that the use of indicators can lead to an overestimation of both the risks and of the benefits if not taken for what they are. Indicators are much more than a practical tool to answer to doubts coming from policies implementation and they can be easily travised if the limits of their use are not clearly understood.

In particular, there are some important fields of application for which the indicator systems can or cannot be effectively used. These, in general terms, are deducted from a rational analysis of [EPA, 1996] and are:

WHAT INDICATORS CANNOT/HAVE NOT TO DO

- give a complete economic analysis;
- define in an absolute manner acceptable impact levels or progress percentages;
- give priority orders in an absolute sense.

Each of these limits is explained here:

The indicators cannot give a complete economic analysis

The politic decisions have to be necessarily based on a wide range of criteria, which also include costs and benefit of the different alternatives. For example, a system of

environmental indicators can only describe the overcoming or not of a prefixed threshold. But this excludes many other parts of the information:

- **cost of the policies/benefits from the transportation:** for example, the environmental damage derivating from transportation can constitute a substantial cost for the society and the environment but the monetary cost for the solution of the problem can be more expensive. The transportation can bring great benefits that could be lost with the traffic restriction policies. In the last years, many emerging regulations tended to limit the monetary quantification, especially in the environmental field (i.e. the heavily toxic emissions in the atmosphere have to be reduced at any cost to safeguard the human health). Even if this is widely accepted, we do not have to forget that the quantification of costs plays a very important role in the government action at any institutional level. The indicators will unlikely give complete and precise information about, for example, the costs distribution about the environmental impacts;

- **policies efficacy:** at the moment, how much can be reduced an environmental impact by a flexible policy measure? It is difficult to identify a measure that by itself improves in all aspects of the situation described by an indicator.

The indicators cannot define in an absolute manner acceptable impact levels or progress

Indicators that show “wide” impacts could be interpreted as indicating the fact that determinated actions can be implemented to solve determinated environmental problems. This would not be a completely correct interpretation, at least according the purely economic vision of the world. The neoclassical approach of welfare economics admits a certain level of pollution. The level is defined by intersection of the marginal cost of the pollution reduction and the marginal cost of pollution itself. The society might not be willing to improve the environmental quality further since it would be too expensive. But political factors, the public opinion and also

legal needs make the reality much more complicated than this simple economic discussion. The point is simply that an indicator that seems to show a “wide” effect is not a sure evidence that something has to be done.

The indicators cannot give priority orders in an absolute sense

In some cases indicators cannot be expressed in units that are not comparable among themselves: for example Euros/certain effect or the number of people who had an accident. In these cases it is clearly very difficult to use indicators to establish a priority. Even when we use units apparently comparable, like emissions or releases measured in tons, the results are not comparable because one ton of benzene causes more damages than one ton of NO_x and the damage can be bigger if the ton is released in a water supply near a town or if it is emitted in a rural area.

Again, also when indicators are expressed in comparable units (i.e. in number of people influenced or in Euros of damages) it can still be inadequate to establish priorities just based on these indicators. This happens because the costs of policy measures are not taken into account. For example, even if soil erosion is a bigger problem than the storage of used tires, this can be much less expensive and therefore much easier to solve in the short term. For this reason the setting of priorities that take into consideration a variety of aspects can bring bigger environmental, social and economic benefits in particular if confronted with a limited budget.

Furthermore, it is known that the society often establishes some approximate priorities based on the form of some problems instead than on the costs of the study of these problems. It can be reasonable to use indicators as a first step of priority regulation, in the distribution of the budget resources, for example, where the profitability analysis would be less practical.

Despite the limits described above, indicators constitute a powerful tool of policy-making. In particular, the most profitable uses of this tool are illustred in the next paragraph.

WHAT CAN WE USE INDICATORS FOR

- to highlight future perspectives;
- to support a global view on a variety of economic/environmental/social impacts;
- to keep trace of the progresses reached by the policies;
- to highlight residual problems;
- to help in defining a priority, especially in the research field or in the one of new policies development;
- to train the population and in general the “outsiders”;
- to be the start-up for economic-political analysis.

Indicators can highlight future perspectives

Indicators can give a sense of the size of the t environmental impacts of transportation even in other fields. For example, transportation could be compared with other sources of environmental damages or these problems could be observed also referring to other big aspects such as health, education, economic and public order. Indicators are very useful in the transportation field to highlight a necessity of wide range. In these cases they can help in the distribution of the resources on the national or communal level.

Indicators can support a global view on a variety of economic/ environmental/ social impacts

During a study regarding the setting up of indicators, it is normal to identify the complete range environmental impacts. Furthermore, thanks to the use of indicators, politicians and the public opinion become aware of the entire range of the impacts that the transportation has on the economic/environmental and social sectors. The

awareness and education that derive are the benefits often forgotten by the use of indicators.

Indicators can keep track of the progress obtained by policy measures

Indicators allow us to keep track of the obtained progresses and allow us to measure success. While the results of a particular initiative of a certain policy are clearly not distinguishable, the general effects of all our activities, projected and not, can be observed with the right indicators. This can give us the answers that allow us to correct in the middle term and to learn from the experiences of the past.

Indicators can highlight residual problems

By using indicators in order to have a complete view of the environmental impacts, we can encounter a “hidden” problem: something that has been neglected or denied. Indicators encourage a continuous complete revision of the cognitive process and can then highlight the areas that have been ignored or not enough explored.

Indicators can help in defining a priority, especially in the research field or in the one of new policies development

Indicators can also be useful to establish the research priorities. The potential benefits become bigger when we have a clear view on the most significative economic/environmental/social problems. The review of the complete range can be useful to establish a priority. As said before, indicators should not be used as unique method to establish priorities, but they can be very useful in this process anyway.

Indicators can train the population and in general the “outsiders”

Indicators are useful to train the population about regulations, policies and other challenges. They can give a quite simple description, for example, of the environmental consequences of transportation.

Indicators can be the start-up for economic-political analysis

Indicators are an excellent starting point to analyze a policy process because they allow to obtain key quantitative data for example on environmental impacts.

3 The methodological and conceptual reference frameworks

1992, in Rio de Janeiro was held the important UNCED - United Nations Conference on Environment and Development, better known as the Earth Summit, during which there have been discussed important needs of sustainable development and has been relaunched the use of indicators to support the decision-making process.
From this moment on, international organizations, national environmental agencies, environmental research institutes and national, regional and local government bodies have started a process to develop methodologies to promote the use of indicators to improve the methods of analysis and the data gathering to create support frameworks able to give structure and reference to the information.
The main and most authoritative references are, above all, OECD, UN and EEA.

3.1 The indicators set of OECD*, UN-Commission on Sustainable Development* and *EEA*

The three main international organisations active in the development and environment field (OECD, UN-Commission on Sustainable Development and EEA-European Environmental Agency) have proposed three base reference frameworks.
The approach developed by OECD has been officially published 1993 and is known as the Pressure-State-Response (PSR) framework.
This framework has the goal to give an interpretation of reality after three reference categories tied by causal relations: the different activities have on the environment a

pressure which modifies its normal state on both the qualitative and quantitative aspect. To react to these changes we can adopt actions with the aim to eliminate the revealed problems.
Following such a scheme, indicators are then classified in the following three categories:

1) *indicators of environmental pressure*, that are connected with the evaluation of the effects due to human activities (that are themselves the driving forces, that is the generating factors of pressure). These indicators are subdivided into direct and indirect indicators;
2) *indicators of environmental conditions*, that allow to measure the quantitative and qualitative state of available resources, and tend to include as well as the condition in which the environment finds itself, also the effects of the impact that the environment has to face;
3) *response indicators*, that measure the variation, in qualitative and/or quantitive terms, of the actions derived from the formulation of accomplished environmental and territorial policies, with the goal of measuring the efficacy of such policies and their degree of application.

The PSR approach has been the first to allow the integration of the environmental measures in precise conceptual categories of reference.
The PSR needs two specifications: first che OECD recognizes that proposed causal nexus alone is not enough to explain the complex relations among the different environmental factors, since there are of serious difficulties to single them out. Second, we recognize the difficulty to reconcile such a leveling model including several environmental subsystems characterized by their own geographic situation. For this reason the OECD suggests to always support a study with an analysis of the territorial and reference context, possibly for every indicator.
Since 1993 the OECD proposed a list of indicators divided into three categories that has been periodically updated and revised but that remain mainly oriented towards an environmental vision and so still distant from an integrated vision with the economic, social and institutional systems characterizing the concept of sustainability.

The UNCSD elaborated a reference framework for indicators with the goal to generate a support oriented toward sustainability policies instead only toward the environmental ones.

The final framework includes the one proposed by OECD with the substitution of the term “Pressure” (P) with the term “Driving Force” (D), that then become Driving Force-State-Response (DSR).

The DSR structure does not represent a functional framework for the selection of indicators, but constitutes a proposal for the selection of indicators referring to a list of criteria based on the respect of some precise indications.

The term “Driving Force” is characterized by a wider meaning with respect to the “Pressure” one, and with the indicators referring to this category we want to represent all the activities that can directly or indirectly generate an impact, causing environmental, social or economic critical states or negativity. The Driving Force indicators allow to identify strongly interdisciplinary aspects with a certain degree of timeliness.

The State and Response indicators maintain a meaning similar to the one proposed in the PSR framework, with a particular reference to the dimension of sustainable development.

The UNCSD defined, since 1995, a own reference list of indicators as result of a participated project carried out by some Member Countries, based on a structure of topics and subtopics that has been periodically modified and updated. This allowed in the first place to highlight some limits of the DSR model, for example showing the use difficulties in applications different from the environmental ones due to the “arrangement” problems of indicators in the social, economic or institutional dimensions. In the second place, this allowed to refine the political competence of some indicators and to allow the later evaluation of the policies themselves.

As in the case of OECD framework every indicator has its own methodological report that explains everything necessary for the use of the indicator itself (procedure of calculation, necessary data, etc.).

The European Union first adopted the conceptual framework PSR, accepting the founding thesis of the causal relations between pressure, environmental state and response.

Then the presentation of the DSR model by the UNCSD inducted the EU, through its own EEA (European Environment Agency), to modify the PSR framework to come to the actual Driving-Force, Pressure-State-Impact-Response (DPSIR) framework.
The categories of the DPSIR are:

1. *Indicators of Driving-Force*, give information about the factors that determine the environmental pressures;
2. *Indicators of Pressure*, put in relationship with the different activities compared to various environmental areas where they act like pressures giving information;
3. *Indicators of State*, give information about both the qualitative and quantitative characteristic of the environment;
4. *Indicators of Impact*, measure the effects on the ecosystem and on human health deriving from the factors of environmental pressure;
5. *Indicators of response*, refer to the measures to realize to improve the state.

The DPSIR framework admits linear causal relational with “star-like” retroactive relations, highlighted in the following figure.

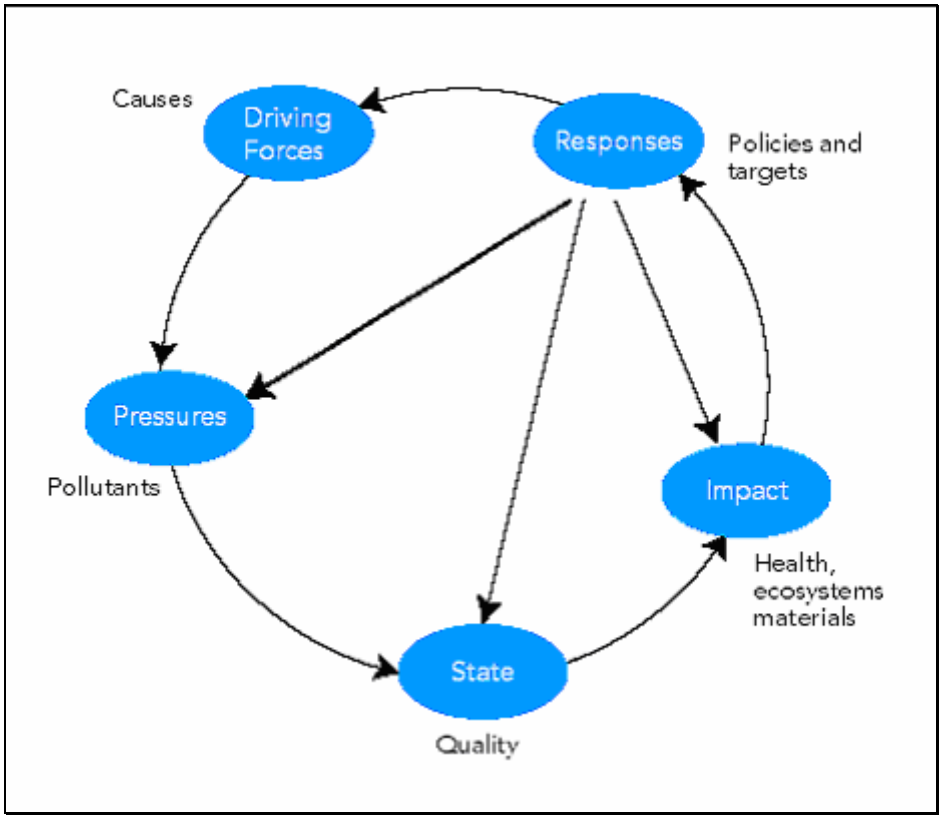


Figure 4 – The DPSIR framework.

Source: [EEA, 2001]

The framework is based on the predisposition of a refined set of environmental and territorial research that is itself based on a system of aimed indicators with the ambition of being able to act punctually and to optimize every expected effect in relation to the efforts done.

The indicators list proposed by the EU is the result of a long process that has involved a big group of experts of the different Member Countries and of different organizations.

The effort inside the EU is to find an answer to the exigence of integration of the indicators lists even if it is difficult to eliminate obvious contaminations and overlappings that define at the base the relational nature among the components of a territorial system, what bring us to a process without excluding new and additional proposals.

3.2 Indicators for the transportation systems

How we can understand from the analysis of the main international experiences about the identification of methodologies for the right use of indicators, all the "building" processes of the indicator sets have to be prepared and conducted with reference to a guiding scheme proposed in advance.

One of the main goal of the MONITRAF project is to analyse the impact of transalpine road traffic, in particular along the four transit corridors of Frèjus, Mont-Blanc, Gotthard and Brenner.

For this reason the study emphasized the necessity of concentrating on the choice, the definition and the harmonization of indicators that refer to all the impacts generated by the transportation activities on the three dimensions of sustainability already identified (economy, environment and society, functionally connected to the institutional dimension).

Consequently, in the following definition of the proposed framework, we will refer mainly to experiences or studies done in the context of transportation activities.

Obviously, this does not exclude the chance to also anlayse indicator systems not necessarily referred to the dimension typically of the transport. On the contrary, in the present study we will also present indicators or elaborations of indicators generated in contexts to analyze very different situations, but that are useful to achieve the aims naturally derived from the general aims of the MONITRAF project.

4 The selection of the right indicators

After having introduced the most important subjects concerning the analysis of the effect of the transportation systems based on the global system of the sustainability dimensions with indicators, it is now possible to go on to the definition of the framework of this work-package and to suggest a reasoned list of chosen indicators. Not before having also defined the characteristics of an “ideal” indicator on the transportation problems, here explained, that will allow us to consider furthermore in theory the presented list of indicators.

4.1 Characteristics of an ideal indicator

Before defining a reference framework, it is necessary to fully treat the problem of the identifying the right indicators. Limitations on the data side or practical restrictions often force to use indicators not at all ideal. That’s why it is important to take into account how an ideal indicator should look like, in order to implement better measurements in the long term.

We can state that an ideal indicator should have the following characteristics:

- to be result oriented;
- to only concentrate on the impact due to the transportation activities;
- to be enough detailed for a wide diffusion;
- to be present with comparable measurement units (i.e. physical or monetary units);
- to be present with significant measurement units (i.e. compared with a standard or goal);
- to gain a reasonable levels of certainty.

In short, an indicator should carefully describe the impacts caused by the transportation with units comparable between an indicator and another, and ensuring a clear sense of the impact relevance. Here will follow a comment about the characteristics stated before.

1) Result oriented

Indicators oriented on the results concentrate themselves directly on the effects like health, the state of environment or the welfare. The advantage of result-oriented measures is that they measure the factors really perceived. Unfortunately measurements of this kind are usually poor. Sometimes the indicators have to be based on models, so that the measurement becomes less certain.

Another problem is that the purely result-oriented measurements do not give any information about the possible solutions or on the causes. It is therefore necessary to introduce further indicators.

2) Only concentrated on the impact due to the transportation activities

Often there are available data on an aggregated level: for example it is quite easy to find out the number of people suffering of respiratory diseases. But it is difficult to find out the number of sick people after the different pollution kinds or sources.
The variety of air pollution sources tells us that it is difficult to find out the rate of the impact due to the transportation only by measuring the pollution levels in the environment.

3) Enough detailed for a wide diffusion

The conception of indicators has to take into account the “users”. The indicators suitable for a regional office could be not suitable for supranational bodies. The suitable level of detail depends on the users of the information; it is then necessary to find the balance between the excess of details and the excess of superficiality.

4) Presented with measurement units comparable

The ideal indicator should be presented with comparable units, to make possible the comparison among different spheres. A good measurement unit could be the monetary one, but for example in the environmental field, it exists a lot of uncertainties or controversies. Often it is more exact to refer to “scientific” measurement units suitable to the context.

5) Presented with significant measurement units

Significative measurement units can give the sense of the importance of an indicator. For example indicators expressed in “tons per year” cannot give information about how many tons can be detrimental. Comparisons with a standard value can instead give a context to the indicator. The standard could be a value fixed by a regulation or

by a political decision process. Unfortunately generally accepted standards do not exist or are difficult to define.

6) With a reasonable level of certainty

An ideal indicator should have a reasonable level of certainty. Almost all indicators of national level have some uncertainty level. For example we can have values obtained with the interpolation of a partial series of measures. It is always important to well balance the purpose of having result-oriented indicators with the purpose of having a reasonable certainty.

4.2 The proposed framework: how to select an indicator

A further useful reference before of illustrating the proposed framework is the scheme here reported, which highlights how the definition of the goals and the actions develop in a parallel way with the definition of the role of indicators and the consequent selection.

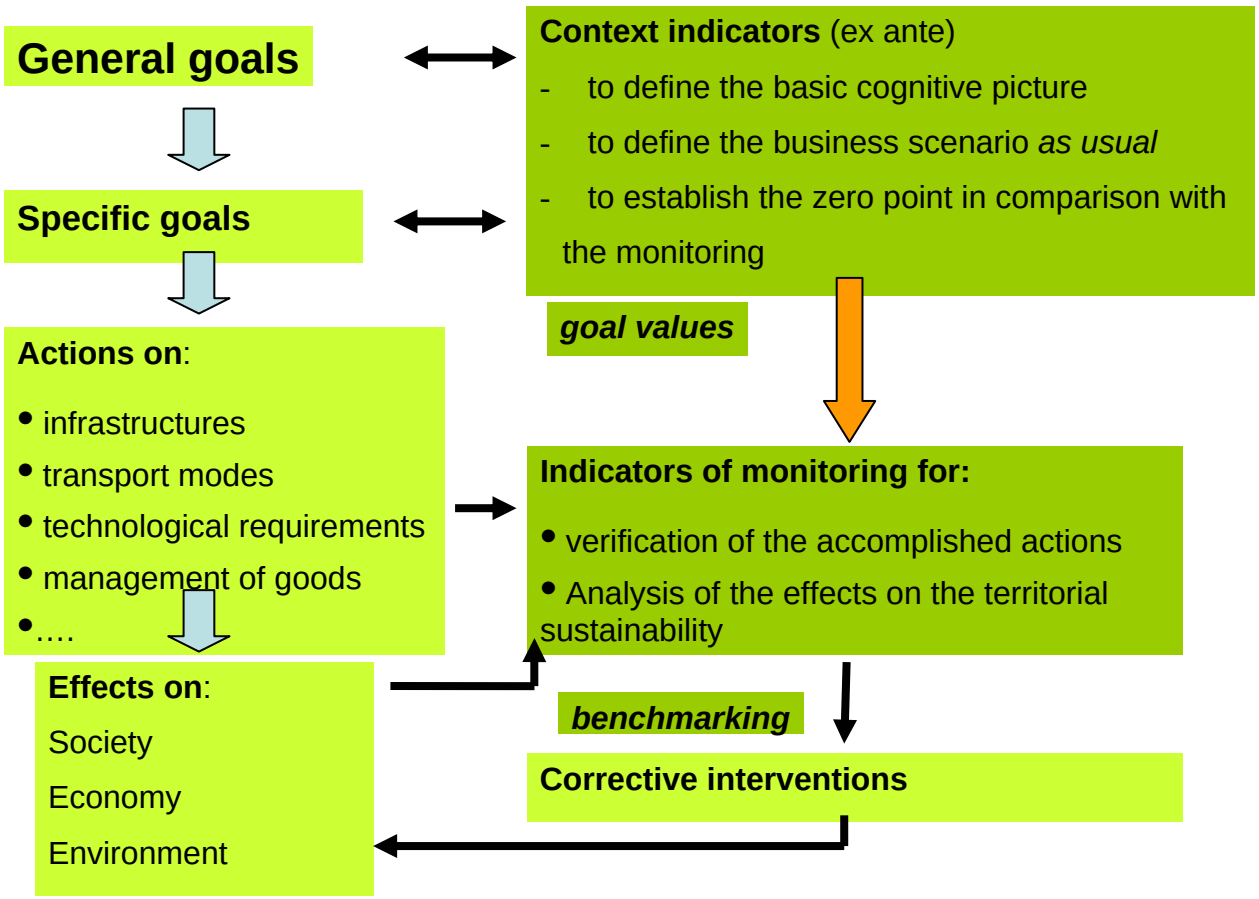


Figure 5 – Goals, actions and indicators.

Elaboration ARPA Valle D'Aosta-IRE.

We also want to highlight that this study aims at giving an interpretation of the reality by means of the indicator categories belonging to the DPSIR framework.

The guiding scheme of this study for the presentation of the indicators has been derived from the analysis of different experiences in different contexts and with different aims.

The study carried out by [EPA, 1996] has been judged very interesting because it is essentially referred to the analysis of the impacts due to the transportation system on the natural environment.

The indicators will be presented taking also into consideration another important approach, the one proposed by the "TERM" process, jointly directed by the EEA and by the European Commission (Environment DG, Transport and Energy DG, and

Eurostat). This kind of approach that concentrates on the identification of the key problems stemming from the transportation system, will allow the development of a detailed structure and focused on the goals of the MONITRAF project.
Also the Indicators system of the Convention of the Alps, for its obvious reference to the alpine spaces, is an important reference useful to understand the approach created inside this study and presented below.

The main aspects of this important project are explained in short in the following three paragraphs.

4.2.1 Indicators of the Environmental Impacts of Transportation of EPA

A first important reference for this work-package, is the analysis of EPA [EPA, 1996].
The report prepared by EPA and DOT/BTS presents national quantitative evaluations of the impacts the transportation system causes on the natural environment. The document includes all the main means of transport modes (road, rail, air and sea) and all the environmental dimensions (air, water and land resources) and discusses the complete “life-cycle" of transportation, from the construction of the infrastructure and of the vehicles to the elimination of vehicles and their parts. The report presents both the quantitative data and a structure to develop the different kinds of indicators and to divide the transportation activities into categories regarding the environment effects. This structure is useful to understand the limitations and uses of the different kinds of indicators and to identify the existing deficiencies of the actual data. In some cases, where the measured indicators were not available from the existing sources, new indicators have been specially developed for this report. The document ends with a description of the further steps necessary to go on with the use of indicators for the environmental impacts of transportation.
The scheme here, presents the framework followed by EPA for the designation and selection of the indicators. This shows how the transport-related activities (i.e. the construction of infrastructure) generate some impacts. This framework also highlights how indicators can be focused on every of the different stages represented in the

figure: indicators can be used in the measurement of the causes that are at the root, like the changing the soil use, or in the measurement of the activities themselves, or in the measurement of the output of these activities (i.e. emissions) or, in conclusion, in the measurement of the results (i.e. the changing of the health conditions of the population). The scheme shows also how the so called activities “exogenous” to the transportation system make it difficult isolate the impacts of the transport (i.e. the industry production, which contributes to total emissions) in the measure of, for example, the pollution levels in the air.

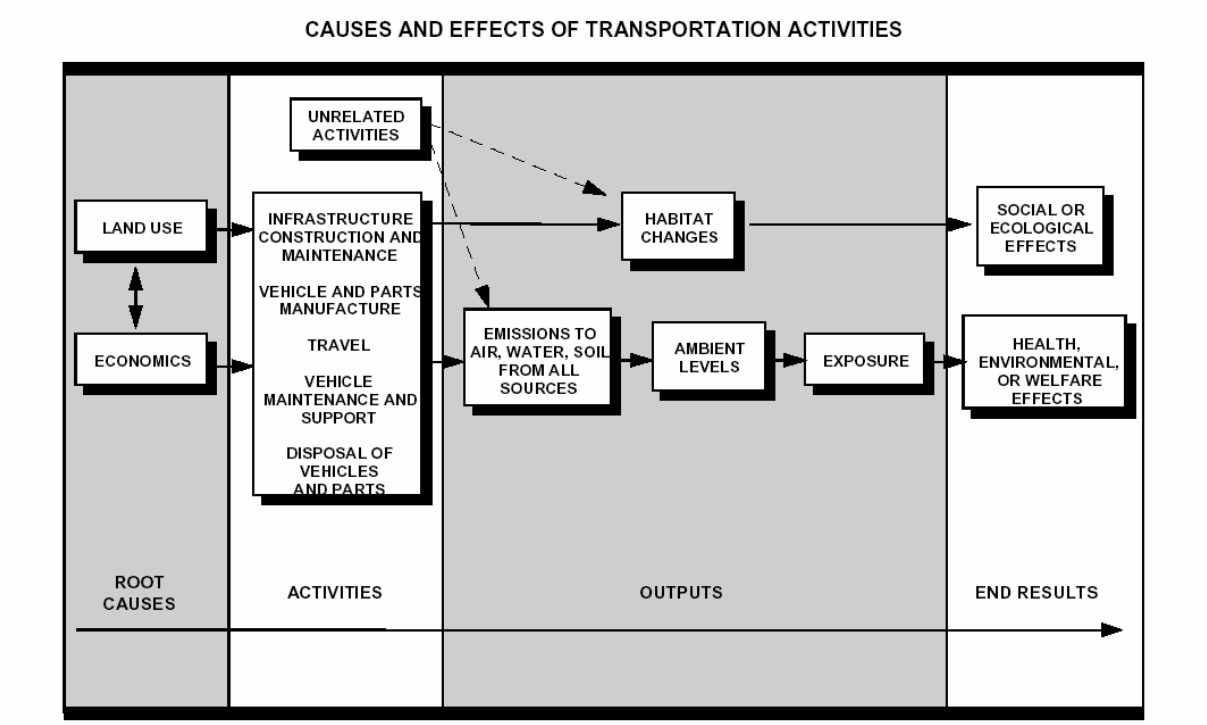


Figure 6 – Causes and effects of transportation activities.

Source: [EPA, 1996].

The shown phases are listed in following with some examples included in every phase or in what could be measured in every phase. For the main part, these are not completely developed indicators and they are not necessarily the real quantitative indicators presented in this study. They are simply representative examples of the range of factors that could be measured.

We think it is of particular interest to report on the four kind of indicators used to analyse the different phases presented in the above scheme about a complete transportation cycle.

In particular, we identify four fundamental kinds of indicators:

1) Indicators of cause

The indicators of cause give information about the factors that imply the transportation system, like for example the soils exploitation, the demographic aspects and the economy, that affect the transportation activities. Even if these measures do not give the direct information for the evaluation, for example, of the consequences of transport on the environment, they do contribute to explain the reasons why determined effects can increase or decrease. That is why we find out the causes that are the root of the problems having useful implications in the policies formulation. Some examples could be:

SOIL EXPLOITATION (including demographic aspects)

- growth rate of the population;
- density (commercial, residential, etc.);
- accessibility.

ECONOMY

- cost of the traffic for different modes;
- revenues;
- attitude towards the environmental protection, attitude towards the transportation problems, etc.
- level of knowledge about the costs of transportation (intern and environmental) and the alternative transportations measures.

2) Indicators of activity

The indicators of activity give information about the “actions” that concern the transportation, like the construction of the infrastructures and their maintenance; and the traveling activities. Furthermore, the transportation infrastructure and the characteristics of the fleet are included as indicators, because its evolution has continuous effects (i.e. on the habitat fragmentation). The activities often have direct environmental consequences and tend to be the most traceable indicators over time. But the level of environmental damages, connected with a specific or general activity based on the infrastructure, varies from place to place and over time. Some examples could be:

CONSTRUCTION AND MAINTENANCE OF AN INFRASTRUCTURE

- number of kilometers built annually;
- percentage of paved/not paved streets.

TRAVELLING

- passengers per kilometer;
- number of trips;
- average percentage of employment;
- modal split;
- congestion levels;
- liters of consumed fuel.

3) Indicators of output

The indicators of output give the information about the soil consumption, emissions, concentration in the environment or about exposition. They give us quantitative information about the changes resulting from the transportation activities. The concentration in the environment can be directly measured. But this is only possible by a definition of a local area (that is, the environmental quality of the air of a metropolitan area, quality of the water for a specific water system) and in this way, the national or local measures about the concentrations in the environment can be expressed in univocal terms.

In addition, only the environmental concentrations do not explain which part of the problem is to be attributed to a specific source (that is, to measure the quality of the air, does not give information about the contribution given by the transportation). On the other side, emissions can be evaluated for a specific kind of activity and traced over time. We still have to remember that the evaluation of emissions is generally based on models which could quite defective and request a continuous improvement over time. Some examples could be:

CHANGING OF HABITAT/SOIL CONSUMPTION

- hectares of land of different kinds destroyed or separated by streets, included the changing in the fragmentation of habitats caused by transportation;
- number of species at risk inside the considerated areas.

EMISSIONS[13]

- emitted tons per mode;
- levels of noise emissions;
- number of vehicles violating the emission standards.

POLLUTION LEVELS

- parts per million of pollutants in the atmosphere per areas, per different time intervals;
- number of days or percentage of areas that do not respect the standard for the air quality.

EXPOSURE TO THE POLLUTANTS

- number of inhabitants in the areas where the standards are not respected;

[13] Also in this study, with the term “emissions” we intend both the pollutants emitted into the atmosphere and those released into the water (even if for the latter would be more correct to speak about "spills").

- estimated level of exposure in ppm/hours or other units;
- population settled in areas with problem of water provision.

4) Indicators of result

The indicators of result are measures of the final consequences. They give the quantitative information about the environmental, social and welfare effects deriving from the transportation activities. Unfortunately the data on the results are often not available or uncertain. The evaluation of the final results generally needs f models (like those of the emissions dispersion, quantity-response or cause-condition-effect) that can request different conditions and introduce necessarily some uncertainty.
It is then difficult to obtain results in comparable units like for example Euros, without a certain amount of additional uncertainty. Some indicators of result often can not be expressed at all(for example, the number of deaths).

EFFECTS ON THE CHANGING OF THE HABITATS

- reducing the number of species caused by the transportation;
- Different detailed measures about:
  - forest impacts;
  - agricultural impacts;
  - bird species impact.

EFFECTS ON THE POLLUTANT EMISSIONS

Estimated number of cancer due to transportation;
risk level (probability that an individual is sick);
costs due to the medical expenses or the welfare.

The indicators listed above represent a wide range of measures about transportation. Thereafter we will discuss how a selection of the most suitable kinds of measure starting from a wide choice, and taking into consideration both the characteristics of an ideal measure and the reality about the actual gaps in the data.

4.2.2 The “TERM” process

The “TERM” process begins in 1998, when the European Council in Cardiff asked the European Commission and the Transport Ministers to define their own strategies about transportation and environment. At the same time, and following the initial work done by the EEA about the indicators linked to transportation and environment, the joint Council of Transportation and Environment asked the Commission and the Agency to constitute a transport and environment reporting mechanism (TERM), with the aim to allow to the policy-maker to measure the progress reached from their integration policies.
In practice the “TERM” process aims to give to the decision-makers and to the public accessible information about transportation and environment.
At the moment TERM includes 40 indicators, that constitute the basic components for the environmental reports regularly published [EEA 2000, 2001a, 2002 e 2004a]. These reports allow to evaluate the progress that different European countries have reached towards the integration goals of the environmental considerations in their own transportation policies; these goals are based on political documents (Sixth Environment Action Program, Common transport policy, European Strategy for Sustainable Development) and on conventions and international agreements adopted by the European Union. The actual set of indicators responds to seven key questions, that are reported in this study:

- Is the environmental performance of the transport sector improving?
  - Group I – Environmental consequences of transportation
- Are the management of the transportation demand and the modal repartition improving?
  - Group II – Demand and transportation intensity
- Is the coordination between territorial planning and transport planning improving?
  - Group III – Territorial planning and accessibility
- Is the infrastructural capacity of transportation optimally used and are we pursuing the rebalancing of the transport system?

  - Group IV – Offer for infrastructure and transportation services
- Is the rating system becoming more equal and efficient, assuring the internalization of external costs?
  - Group V – Prices and costs of the transportation
- How fast are cleaner technologies implemented and how efficiently are the vehicles used?
  - Group VI – Technology and efficiency of use
- How efficient are the monitoring and environmental management tools to support the political and decision-making process?
  - Group VII – Managerial integration

The list of the TERM indicators covers the most important aspects of the transportation system and the environment, following the already mentioned DPSIR scheme. The list represents a long-term vision of the indicators theoretically necessary to respond to the above questions.

4.2.3 The indicators system of the Alpine Convention

A specifically alpine system of indicators has been elaborated by the Work Group "Alpine environmental quality objectives" during a third mandate of the Permanent Committee of the Alpine Convention, and has been presented in October 2004. The elaboration of a report about the State of Environment in the Alps, led to the creation of a list of 95 indicators, each one with its own factsheet. The work has been carried out taking into the due consideration the European systems of environmental and alpine observations and the availability of the data, based on the DPSIR framework for the definition of the functional categories. After having defined a selection procedure of the indicators, fixing choice criteria and types of indicators, the list based on the general goals of the Alpine Convention has been selected and defined in the articles 2, 3 and 4:

- Goal 1: population and culture;
- Goal 2: protection of the air quality;

- Goal 3: soil protection;
- Goal 4: water economy;
- Goal 5: nature and landscape protection;
- Goal 6: mountain forests;
- Goal 7: mountain agriculture;
- Goal 8: tourism and free time;
- Goal 9: transportation;
- Goal 10: energy;
- Goal 11: waste economy;
- Goal 12: territorial planning;
- Goal 13: systematic research and observation;
- Goal 14: cooperation in the legal, scientific, economic and technological sectors.

It has then been possible to clearly highlight the connections between indicators and goals of the Convention, permitting a purely alpine vision of the discussed problems. As already stated, the list aims at the elaboration of a report about the state of the environment, but opening prospectives like the options to build a base for new goals of sectorial quality or a further regionalisation of the indicators for the processes of Agenda 21.

4.3 The proposal elaborated for this study

The analysis of the theoretical assumptions presented in the introduction of this study, together with the analysis of the reference documents identified in the EPA study, in the different reports about the TERM process and in the Final Report of the Workshop Group “Environmental Objectives and Indicators” of the Alpine Convention resulted in a predisposition of a structure of an indicator system referring to the goals of the MONITRAF project.
Similarly to the TERM process, that aims at evaluating the progress toward the integration goals of the environmental considerations in the transport policies by

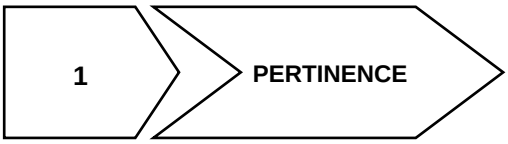
means of a set of indicators organized in groups that respond to seven key questions, it has been created a list of 10 key questions strictly referring to the goals of the MONITRAF project.

1) Improvement of the environmental performance in the transportation sector (Environment)
   - Group I – Environmental consequences of transportation
2) Improvement of the organization of the transport sector and of the coordination between territory and transport planning (Transport organization)
   - Group II – Demand, accessibility and territorial planning
3) Improvement of the direct efficiency of the infrastructural system on the transportation system (infrastructure)
   - Group III – Use of transport infrastructures
4) Improvement of the efficiency and increase of the equity of the rating system (prices and regulation)
   - Group IV – Costs and rates of transports
5) Improvement of the technological processes connected with the transportation system (technology)
   - Group V – technologies and transport efficiency
6) Improvement of the information, the education and the support to the decision-making process in the transport sector (behaviour)
   - Group VI – Information and education
7) Improvement of the economic conditions (economy)
   - Group VII – Economy performances
8) Improvement of the cultural identity aspects, of the population social condition and of the level of availability of vital resources (society)
   - Group VIII – Cultural/social and of vital resources potentials
9) Improvement of the level of turistic attractivity (tourism)
   - Group IX – Touristic dotation
10) Improvement of the general conditions of life quality (life quality)
   - Group X – General conditions of life quality

The analysis of these key questions allowed a discussion about the contents of the different lists of the investigated indicators and also the research of further indicators defined interesting in reference to the fundamental purposes of the project, the results of which constitute the list created and presented here (see document in the appendix).
For a further articulation of the indicators proposed it is also suggested a division in a structure this study, that take its starting point from the definition of identifiable indicators in some ways as “main”, proposed [OECD 2003] and also drowned on by [Alpine Convention, 2004]. The division is articulated according to “Core” and “Key” indicators.

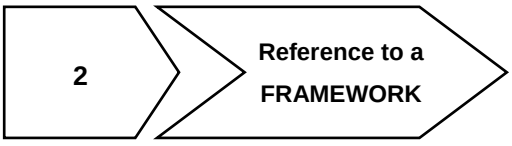
This further articulation is based on the characterization of the general criteria presented above, about the goals of the MONITRAF project, here specified:

1) Criterion of pertinence



The pertinence of an indicator is measured in reference to degree of satisfaction the indications requested by the goals of the MONITRAF project. In particular, the selected indicator should be first of all about the measurement of the repercussions of the traffic on the alpine area. Obviously a reference to the pronounced goals is assumed when the goals can be expressed in detail and when the indicator is able to determinate its range.

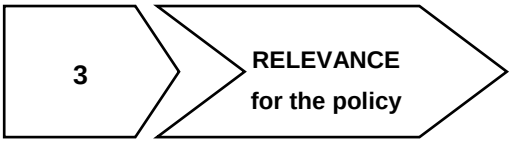
2) Criterion of reference to a framework



The reference to a framework is to understand as a measure of the significance of the scientific foundation of the indicator. In this study an indicator can be classified as

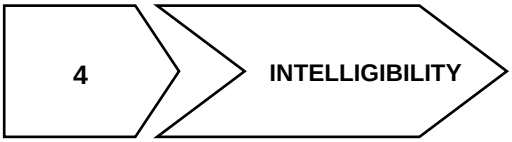
scientifically sound if based on the international standards and if already confirmed in preexisting indicator systems (like for example the presented core set of EEA, the system of indicators of OECD, …).

3) Criterion of policy relevance



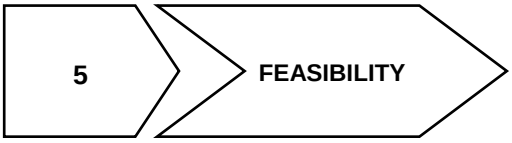
The indicator has to be able to easily generate common measures that aim to the reduction of negative impacts of the traffic and to the improvement of the life quality in the alpine area.

4) Criterion of intelligibility



The indicator has to be easy to interpret (it needs clear measure units, known values scales, clarity of the indication of the intensity of the measured phenomenon), also considerating the fact that one of the goals of the MONITRAF project is to make the public opinion aware of the traffic problem.

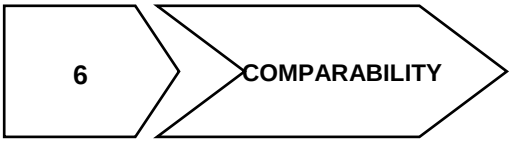
5) criterion of feasibility



The feasibility is measured referring to the existence of the correspondent data bases. The choice of the indicator should consider both the aspects about the continuity of the data gathering and the effective availability of the data. Not to forget is that the four corridors analysed in the MONITRAF project concern four different

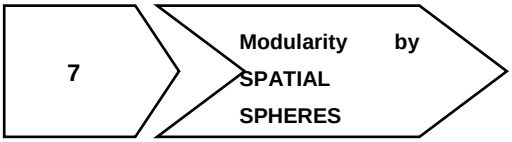
countries with gathering and treatment methodologies that can be very heterogeneous.

6) Criterion of comparability



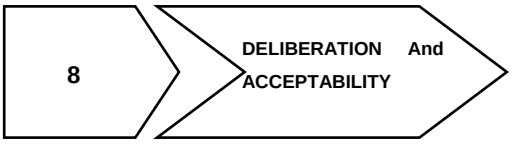
The comparability is measured in reference to the aspects about the definition and the method of data treatment proposed for the indicator that should be as homogeneous as possible for all the regions considered in the project, and in reference to the schedule because a good indicator should be able to reproduce time trends.

7) Criterion of modularity by spatial spheres



The data requested to populate the indicator should be georeferential, so that it will be possible to ”distribute” the results on the territory and to obtain a true analysis focused on the different analysed regions.

8) Criteria of deliberation and acceptability



The indicator has to be convalidated through a participated process or the convalidation should come from international standard possibly created for the application in the alpine area.

In particular, the indicators defined as “Core” are indicators that give a picture about the main thematic sphere for the political decisors and for the public discussion. It is

in fact possible to keep trace of the involved factors and of the possible improvement in the analysed economic, environmental and social performances.
In this study the “Key” indicators are a restricted group of indicators of particular interest, obtainable from the group of “Core” indicators responding to wide communicative purposes and of particular importance to give a clear and immediate information to the public opinion in general.

In the process is then presented a motivated selection of “Core” indicators, that has been obtained by the comparison of the different proposals coming from the partners of the project on the base of the analysis of the presented indicators, and a selection of “Key” indicators, where the former result particularly “strong” in reference to the goals of the MONITRAF project.

The particular selection both of the “Core” indicators and, in consequence, of the “Key” indicators, can naturally be wide-ranging or restricted, so that it can react both to the scientific progress and to the changing of the political importance of some goals.

5 Detailed presentation of the indicators

5.1 The analysed sources

Different sources stemming from experiences on the national, international and community level have been analysed. These analyses allowed, even if not in all cases, to find a lot of indicators, often triggered for the analysis of the transport sector referring to the alpine territory.
These sources are shortly presented in the following paragraphs:

- *Indicators of the Environmental Impacts of Transportation di EPA*[14]

The report made by EPA presents quantitative estimates (calculated on the national level) of the intensity of the impacts due to the transportation on the natural environment. The study considerates all the primarily ways of transport (road, train, air and maritime transport) and all the environmental matrixes (air, water and territory) and cover the complete “life-cycle” of transportation, from the construction of the infrastructure and of the vehicles to the disposal of vehicles and their used parts. The information presented in the study highlights the fact that the impacts of transportation are multisectorial and that’s why they do require a multidisciplinary approach.
Furthermore, the main purpose of presenting data, the study presents a framework for the development of different kind of indicators and for the categorization of the transport activities that affect the environment. The framework is useful to understand the limits and the possible uses of the different kind of indicators and to identify the possible gaps in the data availability. In many cases, when the data could not be gathered for the implementation of specific indicators, there have been alternative indicators inside the study itself.
The report ends with a description of the possible steps that one should take for a future development and use of indicators in the evaluation of environmental impacts of the transport activities.

- *The mobility in Italy: indicators on transportation and environment synthesis Data – 2005*[15]

The report elaborated by APAT (the Italian agency that carries out scientific and technical activities in the national interest to protect the environment, water resources and the soil) gives in a short form a general description of the indicators proposed by EEA in reference to the TERM process. TERM (Transport and Environment Reporting Mechanism), as illustrated, is a monitoring mechanism that form one of the

[14] *[EPA, 1996].*

[15] *[Contaldi, M., Pignatelli, R., 2005].*

evaluation tools of the Community transport politics and so, give important guide lines for the development of the EU policies.
The analysed document also presents, in general, enough significant data. Instead, other indicators, as there is not suitable data available, the document contains only approximate data of the considered phenomena. Generally, the quantity of available data on a national level allows the implementation of a reasonable quantity of indicators, even if you cannot yet reach the requested precision of the actual TERM scheme.

- *Document the Transformations of the Alpine Habitat: indicator system and Project of a report about the Alps State 16*

The study has been carried out by the work group "Environmental goals and indicators" of the Alpine Convention.
Suitable indicators for the core themes of the Alpine Convention were created and on their base there was possible to present a project of Relation on the Alpine conditions.
The report presents an in-depth proposal about a system of indicators for the alpine arc, after an attentive evaluation of the existing national and international indicators systems and after a research in depth of the possible data sources. In the report it is also presented a detailed documentation of the indicators in three relative factsheets. It is also defined that the presented indicator system will have to be harmonized in future with the structure and the contents of the single national accomplishment reports.

- *Indicators as instrument of politics strategic conduction*

a report of the Swiss Federal Council of 25th February 2004[17]

[16] *[Alps Convention, 2004].*

[17] *["Indicatori quali strumenti di condotta strategica della politica", 2004].*

The report has been drafted by the Federal Chancellery and by the Swiss Federal Statistical Office starting from 2001, after a postulate of Parliament that requested the creation of an indicator system to control the evolution of the Swiss policy.
After having determined the choice criteria of the indicators, it has been developed an indicator system on two levels, grouping 100 indicators in a set of 15 indicators of superior level (Parliament/Federal Council) and of 85 indicators of sectorial level (Administration). The choice of the indicators referred to the structural Indicators of the European Union[18] and the UNO Millenium Development Goal Indicators[19].
Of particular interest are the chapters 1.4 of the part 2 grouping the indicators about the "environment and infrastructure" theme.
The report has been thought as a tool of practical use by the Federal Council and as base of a further check report.

- *"Expanding the Measure of Wealth - Indicators of Environmentally Sustainable Development"*[20]

The study has been accomplished by the World Bank Environment Department to respond to multiple needs: the one to develop environmental indicators useful to the evaluation of the investments n development projects by the World Bank, the one to expand the set of environmental indicators presented in the World Development Indicators and the one of keeping on the general research work about the indicators of sustainability.
The report has generated by the Indicators and Environmental Valutation Unit and it is mainly focused on indicators that can trace the progresses of Nations in the aim of a sustainable development. The study includes new evaluations of the national richness and savings levels and a new detailed analysis of the changes in the subsidies that can affect the environment and contribute to the conceptual definition of the "social capital" idea.

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[18] http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1133,47800773,1133_47802558&_dad=portal&_schema=PORTAL, *visited 07/2006.*

[19] *http://mdgs.un.org, visited 07/2006.*

[20] *[The World Bank Environment Department, 1996].*

Even if many estimates are not yet definite or even certain, these strengthen the importance of the role of the natural resources, that are the base of economies, and in the same way strengthen the fundamental role of human resources (including both the concept of human and social capital) in the determination of the national richness level and of the creation of the social welfare benefits.
The World Bank proposes this new approach to contribute to the creation of a sustainable development paradigm based on the ecosystem vitality, on the economic strength and on the equity of the social system.

- *REDI: Performance Indicators for Transport*[21]

To respond to the general trend of lost in quality of the data about the transportation sector, the World Bank has thought about an action of revitalization in particularly focused on the infrastructures, named Infrastructure Action Plan.
One of the instruments developed as part of the Infrastructure Action Plan is an evaluation called “Recent Economic Developments in Infrastructure” (REDI). The goal of this instrument is to focus the attention on the level about any nation by the presentation of quantitative information. REDI wants to be a guide to analyse the infrastructure sector both as a sector on its own and also as a subsector logically connected with others. The study analyzed and proposed in the literature list presents a wide list of indicators particularly about the transportation sector and divided into logical dimensions (i.e. Access, Quality - Technical Dimension -, etc.).

- *Indicators for the integration of environmental concerns into transport policies*[22]

The report is part of the work program of OECD about the environmental indicators and is focused on indicators for transportation and environment. The process begins with the consideration that the transportation is one of the main components of the

[21] *[The World Bank, 2004].*

[22] *[OECD Organisation for Economic Co-operation and Development Environment Directorate Environment Policy Committee Working group on the state of the Environment,1999].*

economic activity but has strong impacts on human health and environment: the purpose of indicators is then to promote the integration of environmental problems into the transportation policies.
The framework used to develop the indicators is PSR, as usual: the indicators considerated are about traffic, infrastructures, vehicles, use of energy resources, air pollution, risks and safety on the road and the prices and rates system.
The analysed data come from data bases of the OECD countries.
The indicators are defined to reveal trends and focus the attention on particular phenomena or changings. It emerges that the interpretation of the results is not considerated but left to further work programs.

- Atlante socioeconomico della Regione insubrica[23] (socioeconomic atlas of the Insubric Region)

The document represents the conclusion of a research started in 1993 by the "Istituto di Ricerche Economiche (IRE)" in Lugano, Switzerland, and concluded in 1996 in cooperation with the Istituto di Geografia Umana dell'Università degli Studi di Milano.
The *Atlante socioeconomico* wants to be an instrument able to document and represent the demographic and economic structure of the Swiss-Italian lake region (Verbano, Ceresio and Lario lakes) that lies between the Alps and the Parmesan Plain.
The *Atlante socioeconomico* is based on data managing and elaboration programs, as well as on application software for the cartographic representation. The set of these programs, with the statistic and geographic data bases, can be considered at the same level of a "geographic information system" (GIS), that is an instrument able to acquire, store, access, analyse and represent numerical data at the same time. Having the declared intent to represent socioeconomic data and the territorial dynamics at a territorial and interregional level for what concerns some particular aspects of the territory (settlement, industry and services, urban structure, mobility and use of the transportation, etc.) this document becomes an important indicators

[23] *[Torricelli, G.P., Thiede, L. and Scaramellini, G., 1997].*

source (that in the Atlante is calculated in a precise manner, so that it is also possible to derive useful considerations for their practical use) for the present study.

- *PROPOLIS Planning and Research of Policies Land Use and Transport for Increasing Urban Sustainability*[24]

PROPOLIS is a research project realized within the Fifth Framework Programme of the EU. The goal of PROPOLIS is to research, develop and test integrated policies for the use of territory and the transport management, instruments and comprehensive methodologies with the aim of obtaining sustainable urban strategies on the long term and to demonstrate their effects on some European cities.
To measure the environmental, social and economic dimensions of the urban sustainability it has been developed a set of indicators and the indicators value have been calculated using advanced patterns of the soil use and of the transportation management together with new technologies based on GIS and the internet developed during the project. It has also been used a support system to the decision--making process to be able to aggregate the single indicators into synthesis indexes to describe the alternative options of policy implementation. The biggest innovation about the project is the integrated and comprehensive but at the same time transparent approach used. The used approach has also produced innovative advice for the policies based on the systems' ability to predict the future indicators and to consider their values with the aim to evaluate the effects of the use of the territory in the long term.

- Indicatori regionali per la valutazione delle politiche di sviluppo ISTAT[25] (Italian National Institute of Statistics)

Within the activity of technical assistance to the *Ministero dell'economia e delle Finanze – Unità di valutazione del Dipartimento per le Politiche di Sviluppo e Coesione*, ISTAT compilated a list of regional statistic indicators for the

[24] *[Lautso, K et al., 2004].*

[25] *[ISTAT, 2006].*

programmation and evaluation activities of the interventions to be done in the goal regions 1 of the structural funds 2005-2006.
These indicators are on three levels:

a) indicators of "key contest", about all programmation sectors, as base for the actuation and determination of the specified goals;

b) “break” variables, with the aim to measure the total impact of the PSM;

c) "program” indicators, specific for every thematic areas, of competence of the officials of the single regional and national Operational Programs**.**

The regional data base is composed at the moment of 125 indicators of “key context” and 15 “break” variables (some of which are still in the definition phase), created for the twenty Italian regions, the four territorial divisions (with the addition of the aggregate *Centro-nord*), the Goal regions 1, the non Goal regions 1, and the Goal regions 1 with the exclusion of Molise region that, until the 31/12/06, is in a condition of transitory aids.
If available, the data series started in 1995.

- *Benchmarking of the transportation supply in the alpine regions*[26]

The analysis of territorial benchmarking has been decided by the *IRES Piemonte* inside the Project Interreg III B “AlpenCorS” (Alpen Corridor South) as a result of the research around the Work Package 2-Transport, W.P. 2.113 “The Role of the Region Piemonte in the Alpen CorS Space”.
It is an original research that gathered different kinds of data so to not give only an economic evaluation of the regional systems' performance of the regional transport systems, but to try to give a position analysis of all the regions in the Alpine arc.

[26] *[Ferlaino, F. and Rota, F. S., 2004].*

After a general picture of the mountain areas inside the European policies, it is presented a short picture of the territorial characteristics through an indicators system and then a benchmarking analysis through the creation of dedicated indexes.

As far as the indicators are concerned, it has been calculated 35 indicators for every considerated territorial unit, of the NUTS-2 level.

The study allows in particular to compare the economic structure with the performance of the supply of logistic and transportation services.

Table 3 – SWOT table of the analysed sources.

Elaboration IRE.

Sources	Strengths	Weaknesses	Opportunities	Threats
Indicators of the Environmental Impacts of Transportation di EPA	Focused on the intensity of the impacts on environment due to transportation. Consideration of the main transport modalities. Multisectorial and multidisciplinary approach. Interesting framework proposed, and clear indicators peopling.	Too specific about the American experience. It gives references for calculations of impacts only on national level, does not give details for the local level calculations.	The study is a very good starting point to refine the research inside the MONITRAF project.	It can bring to concentrating too much on environmental aspects and losing the focus on the sustainability dimensions in general.
The mobility in Italy: indicators on transportation and environment synthesis Data – 2005	Particularly oriented on the European transportation problems (Community TERM process). Based on a clear monitoring mechanism oriented on an evaluation of the transport policies. Based on the DPSIR framework, widely accepted and shared in Europe.	Sometimes it presents indicators difficult to calculate in a quantitative manner, and therefore these are populated only with indicative data of the analysed phenomena.	The study is a good base for the analysis inside the MONITRAF project.	It could lead to believe erroneously to finish the MONITRAF analysis just on the conclusions proposed by the analysis of the synthesis data.
Document the Transformations of the Alpine Habitat: indicators System and Project of a report about the Alps State	Explicit elaboration of the indicators referred to the alpine territory. Detailed documentation based on factsheets. Based on the DPSIR framework, widely accepted and shared in Europe.	Sometimes it presents indicators difficult to calculate in a quantitative manner, and therefore these are populated only with indicative data of the analysed phenomena.	The study is a good base for the analysis inside the MONITRAF project.	Its analysis, that do not have to be too deep, could lead to forget important aspects for the MONITRAF project.

Table 3 follow – SWOT table of the analysed sources.

Elaborations IRE.

Sources	Strengths	Weaknesses	Opportunities	Threats
"indicatori quali strumenti di condotta strategica della politica" a report of the Swiss Federal Council of 25th February 2004	Study created to control the conduct of policies. It presents a good number of indicators. Interesting is the "Environment and Infrastructure" theme.	Specifically predisposed for the Swiss situation. Some indicators seem to be too oriented towards an abstracted level.	Good example of instrument of practical use and base for the creation of verification reports.	It can lead to a too simply level of the relationship policies – indicators system.
"Expanding the Measure of Wealth indicators of Environmentally Sustainable Development"	Study that wants to give a concrete contribution to the creation of a new paradigm of sustainable development based on the ecosystem vitality, on strength of economies and on the equity of the social system.	Lack of proportion towards an interest in the economic and social dimension of sustainability. It only presents estimes about the role of the human resources in the determination of the richness and social welfare level.	The study can give concrete directions to the investigation of the socio-economic evaluation of the national systems.	It can lead to a focus mainly economic and in all cases, only on some and specific aspects not directly connected to the transport systems.
REDI: Performance Indicators for Transport	Analysis focused in an explicit manner on infrastructures and transportation. Presentation of indicators mainly of quantitative kind.	Sometimes it presents indicators implemented with data that are only indicative about the analysed phenomena. The analysed source is only a draft and not a final proposal, fact that affects the presentation of the indicators.	The draft is anyway a good basis for the analysis inside the MONITRAF project.	It can lead to forget social and environmental aspects in favor of infrastructural aspects, that are maybe too technical.

Table 3 follow – SWOT table of the analysed sources.

Elaborations IRE.

Sources	Strengths	Weaknesses	Opportunities	Threats
Indicators for the integration of environmental concerns into transport policies	The report is part of the work program of OECD about environment indicators and is about indicators on transportation and environment.	It is highlighted how the interpretation of the results is left for later work programs.	The study is a good base for the analysis inside the MONITRAF project: the considerated indicators are about traffic, infrastructures, vehicles, use of energy sources, air pollution, risks and safety on the road and the prices and rates system.	The framework used to develop the indicators is PSR, this could lead to contradictions because in the WP-7 proposal it has been chosen the DPSIR framework.
Atlante socioeconomico della Regione insubrica	Declared intention to represent socioeconomic data and territorial dynamics at a interregional level for what concerns the marked territory aspects. Precise calculation of a lot of indicators with useful considerations.	Manifest interest only referred to the social dimension of sustainability.	The study can give concrete directions to the investigation of the social and economic evaluation at an interregional level: very interesting for the MONITRAF project.	It can lead to concentrate too much on the social aspects and loose the dimensions of the sustainability in general.
PROPOLIS Planning and Research of Policies Land Use and Transport for Increasing Urban Sustainability	Community research project. Goal is to research, develop and test integrated policies for the use of territory and the transport management. Develop of an indicator set to measure the environmental, social and economic dimensions of sustainability (urban).	The study focuses on the urban area.	The study is a very good starting point to refine the research inside the MONITRAF project.	It can lead to an analysis too technical and difficult to implement in the different areas analysed by the MONITRAF project.

Table 5 follow – SWOT table of the analysed sources.

Elaborations IRE.

Sources	Strengths	Weaknesses	Opportunities	Threats
Regional indicators for the evaluation of development policies by the italian statistical office. ISTAT	Presentation of regional statistics indicators for the evaluation activities of the intervention about structural funds.	Clearly predisposed for the particular Italian situation.	The reference at a regional level is interesting.	It can lead to analysis too specific and hardly connected with the transportation sector.
Benchmarking of the transportation supply in the alpine regions	Analysis inside the Interreg III B "AlpenCorS" project. Multidisciplinary evaluation of the performances of the regional transportation systems. Use of indicators clearly connected with the transportation sector and of indexes suitably created.	The NUTS 2 level on which it is referred, leads sometimes to results not fully satisfying for a specific analysis in the alpine territory.	The study is a good base for the analysis inside the MONITRAF project.	It could lead to believe erroneously to finish the MONITRAF analysis just on the conclusions proposed by the analysis of the synthesis data.

5.2 Detailed presentation of the indicators

According to what has been developed so far, each indicator was described by the following information (see full list of the selected indicators for WP-7 in the appendix):

- Ongoing number and denomination of the indicator;
- General information about the indicator: definition and measurement units;
- Characteristics with respect to the considered criteria;
- Thematic classification: thematic group, DPSIR, specifications;
- Research and methodology of the indicator: source of the indicator, strength and weakness.

N° progr. 00	**Denomination of the indicat**
Ongoing number of the indicator in the general list of the study	Name of the indicator

Information on the indicator

Definition

Short description of the indicator with the specific rules and method to determinate the indicator as well as the territorial area and dimension of reference suitable for the study in case.

Unit of measurement

Unit of measurement such as number of inhabitants, km, ton, Euro etc.

Evaluation with respect to the selection criteria

1 Pertinence

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

2 Framework reference

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

3 Policy relevances

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

4 Comprehensibiltiy

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

5 Feasibility

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

6 Comparability'

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

7 Spatial modularity

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

8 Consensus and acceptability

The color of the arrow represents the degree of satisfying the criteria:

= criteria completely satisfied
= criteria partially satisfied
= criteria not satisfied

Thematic Classification

Group

Indication of the group (reference with the key question posed in the study or study area).

DPSIR

Letter referring to the functional category expressed by the DPSIR framework.

Indicators developed in the context of WP-7 and not referring set of official indicators based on the DPSIR framework are marked with a star.

Specification

Indicators are divided in “Key” and “Core” indicators.

Indicators defined as “core”, are indicators able to give a frame of the main topics and thematic areas to the decision makers and to the general public debate. The generally represent the three dimension of sustainable development.

In the present WP the “Key”- indicators refer to specific topics of the research project Monitraf. However, they can be reconducted to the “core” indicators. .They all have to fulfil an important aim to communicate in a simple and direct way the evolution of the condition under measurement.

Research and development of the indicator

Source of the indicators

Information about the background, used methods, and research institutions developing the indicator.

Strength and weakness of the indicator

Each indicator is evaluated according to the present knowledge, highlighting irs strength and also its weak points, in particular as far as the quality of the available data is concerned.

Notes.

Supplementary notes and remarks.

For each of the indicators, selected during the project phases of WP-7, we produced a single sheet with the detailed information covering the different aspects of the indictors. WP-7 elaborated in this way a comprehensive list of indicators fitting perfectly in the framework of the Monitraf-project and delivered the background information for the further steps towards a simple and intelligible monitoring system to be developed by Monitraf.

6. Conclusion

The freight traffic on the road has experienced in the last 20 to 30 years particular growth rates. Its concentration on a few corridors provokes particular environmental and social impacts. At the same time the transportation sector covers a crucial role in the functioning of the daily life. The solution to these problems is a more sustainable transport and mobility system. However, presently we are still far away from a generally accepted definition of sustainable transport and mobility and even further away from achieving a state of sustainability. A first step towards a more sustainable transport system is to understand the different impacts and the effect of policy measures on the different dimensions.

The scope of this work-package was to select a reasonable set of indicators capable to measure the most important effects and impacts as well as the principle characteristics of a transportation system in the light of a common understanding of sustainable mobility. Previous national and international studies have elaborated numerous sets of indicators covering the impacts of transport. Therefore, the present work-package was mainly focused on the understanding of the role of indicators in a policy decision process. Moreover the work-package has highlighted several times the strength and limits of indicators. A second important aspect of this work-package regards the necessary methodological framework for each indicator set. Different approaches to define a framework have been discussed in detail in this work-package. Without a clear and predefined framework the use of indicators may become more or less useless if not dangerous.

As already mentioned the major challenge in this workpackage was not to elaborate new and ingenious indicators, since may indicator sets are available, but rather to define the criteria to select the most appropriate indicators. A number of selection criteria has been defined and each selected indicator is defined by the degree it fulfils these criteria set. (see appendix).

The result of the work-package is a set of indicators covering the complex interactions and relations between the transport system, the society, the economy and the territory in a perspective of sustainable mobility.

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APPENDIX

INDICATORS' SHEETS

"CORE" AND "KEY" PROPOSAL

DRAFT JULY 2006

Progr. N° 101 Air concentrations of NO_2

UNDERLYING DEFINITIONS

Definition

The indicator considers the carbon dioxide concentrations (NO_2). NO_2 contributes to acid rain, to the formation of tropospheric ozone and, indirectly, to the global warming. Main human sources: high temperatures combustion processes (thermal engines).
The survey can be reported to the NUTS 3 area in which the detector is placed.

Unit of Measurement

[mg/m^3]

CRITERIA EVALUATION

1 PERTINENCE

The indicator measures the presence in the atmosphere of one of the most dangerous pollutant for the human health.

2 FRAMEWORK-orientation

The indicator is included in all the most important lists of indicators on traffic and atmosphere.

3 POLICY-relevance

The indicator is of extreme importance for the control of the air quality and for the development of laws about the protection of the human health.

4 COMPREHENSIBI-I ITY

The indicator is easy comprehensible and it uses a standard unit of measurement.

5 FEASIBILITY

Many campaigns of surveys are being implemented but the availability of data is up to the present insufficient.

6 COMPARABILITY

The comparability is limited by the general lack of data.

7 SPATIAL MODULARI-TY

Spatial modularity of the indicator is good.

8 CONSENSUS AND ACCEPTABILITY

The indicator is validated by numerous sectorial studies.

THEMATIC CLASSIFICATION

Group

Group I – Environmental impact of transport (Environment)

DPSIR

S*

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Rapporto Basler+Partner WP5 MONITRAF

Strengths & Weaknesses

The NO_2 is a good indicator of the impact of the road traffic because of the great majority of the NO_2 produced by anthropic sources comes from the high temperatures combustion processes, like the engine combustions of the motor vehicles. Limitations: the availability of data is extremely heterogenous, because of different methodologies are used and so the comparability is not good.

Comments

Progr. N° 106 Transport emissions of greenhouse gases by mode

UNDERLYING DEFINITIONS

Definition

The indicator measures the annual emissions of the three main greenhouse gases, that is carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_20). The upcoming gas concentration can contribute to the global warming, with negative consequences for ecosystems and human activities.

Unit of Measurement

[$MtCO_2eq/a$]

CRITERIA EVALUATION

1 PERTINENCE

The indicator measures the impacts of the traffic on the climate of the alpine ecosystem.

2 FRAMEWORK-orientation

The indicator is included in all the most important lists of indicators on traffic and atmosphere.

3 POLICY-relevance

The indicator represents a control for the policies development on sustainable mobility and for the reduction of the fossil fuel consumptions.

4 COMPREHENSIBI-LITY

The indicator is comprehensible and it uses a standard unit of measurement.

5 FEASIBILITY

Feasibility is good (according to data availability).

6 COMPARABILITY

The indicator is particularly useful if it is used for the composition of historical series.

7 SPATIAL MODULARI-TY

Spatial modularity is not completely realizable, however it can be calculated.

8 CONSENSUS AND ACCEPTABILITY

The indicator is based on international standards.

THEMATIC CLASSIFICATION

Group

Group I – Environmental impact of transport (Environment)

DPSIR

P

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator is a valid signal of the pressures on possible climate changes due to the transport activities. Limitations: the availability of data is extremely heterogenous, because of different methodologies are used and so the comparability is not good.

Comments

CH_4 and NO_2 emissions are converted to theirs global warming potential (GWP), in order to express their emissions in million tons of equivalent CO_2.

GWP CO_2 = 1
GWP CH_4 = 21
GWP N_2O = 310

The right geographical scale can be obtained according to data availability.

Progr. N° 107 Transport emissions of No_x by mode

UNDERLYING DEFINITIONS

Definition

The indicator considers the No_x emissions. Main human sources: high temperatures combustion processes (thermal engines). Nitrogen oxides contribute to acid rain, to the formation of tropospheric ozone and to the global warming.

Unit of Measurement

[kt]

CRITERIA EVALUATION

1 PERTINENCE

The indicator measures the presence in the atmosphere of one of the most dangerous pollutant for the human health.

2 FRAMEWORK-orientation

The indicator is validated by numerous international framework.

3 POLICY-relevance

The indicator supplies information on the air quality and allows to implement and to evaluate specific policies.

4 COMPREHENSIBI-LITY

The indicator is easy comprehensible and it uses a standard unit of measurement.

5 FEASIBILITY

There are a lot of data sources which allow the analysis.

6 COMPARABILITY

Comparability is good.

7 SPATIAL MODULARI-TY

Spatial modularity of the indicator is good.

8 CONSENSUS AND ACCEPTABILITY

The indicator is validated by numerous sectorial studies.
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THEMATIC CLASSIFICATION

Group

Group I – Environmental impact of transport (Environment)

DPSIR

P

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator is a valid signal of the pressures on ecosystems and on public health due to the transport activities. Limitations: the availability of data is extremely heterogenous, because of different methodologies are used and so the comparability is not good.

Comments

The right geographical scale can be obtained according to data availability.

Progr. N° 108 Transport emissions of VOC by mode

UNDERLYING DEFINITIONS

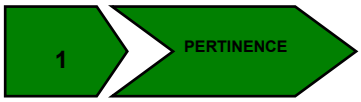
Definition

The indicator measures the emissions of Volatile Organic Compounds (VOC). VOCs are precursors of the photochemical smog and they contribute to the formation of ozone.

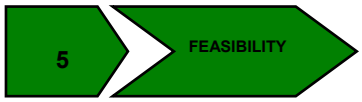
Unit of Measurement

[kt/a]

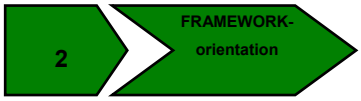
CRITERIA EVALUATION



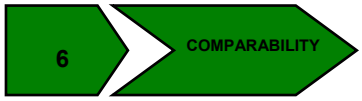
The indicator measures one of the most harmful pollutant for the human health.



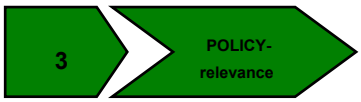
There are a lot of data sources which allow the analysis.



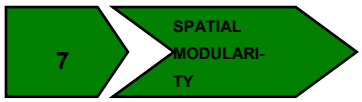
The indicator is validated by numerous international framework.



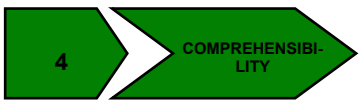
Comparability is good.



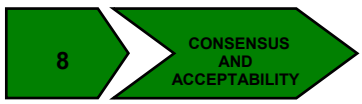
The indicator supplies information on the air quality and allows to implement and to evaluate specific policies.



Spatial modularity of the indicator is good.



The indicator is easy comprehensible and it uses a standard unit of measurement.



The indicator is validated by numerous sectorial studies.

THEMATIC CLASSIFICATION

Group

Group I – Environmental impact of transport (Environment)

DPSIR

P

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator is a valid signal of the pressures on ecosystems and on public health due to the transport activities. Limitations: the availability of data is extremely heterogenous, because different methodologies are used and so the comparability is not good.

Comments

The right geographical scale can be obtained according to data availability.

Progr. N° 109 Transport emissions of PM_{10} by mode

UNDERLYING DEFINITIONS

Definition

The indicator measures the emissions of Particulate Matter (PM_{10}). The Particulate Matter currently represents the pollutant whit the greater impact on the human health in the urban areas.

Unit of Measurement

[t/a]

CRITERIA EVALUATION

1 PERTINENCE

The indicator measures one of the most harmful pollutant for the human health.

2 FRAMEWORK-orientation

The indicator is validated by numerous international framework.

3 POLICY-relevance

The indicator supplies information on the air quality and allows to implement and to evaluate specific policies.

4 COMPREHENSIBI-LITY

The indicator is easy comprehensible and it uses a standard unit of measurement.

5 FEASIBILITY

There are a lot of data sources which allow the analysis.

6 COMPARABILITY

Comparability is good.

7 SPATIAL MODULARI-TY

Indicator Spatial modularity is good.

8 CONSENSUS AND ACCEPTABILITY

The indicator is validated by numerous sectorial studies.

THEMATIC CLASSIFICATION

Group

Group I – Environmental impact of transport (Environment)

DPSIR

P

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator is a valid signal of the pressures on ecosystems and on public health due to the transport activities. Limitations: the availability of data is extremely heterogenous, because different methodologies are used and so the comparability is not good. Moreover the indicator, as already asserted in the description, is valuable for urban areas above all.

Comments

The right geographical scale can be obtained according to data availability.

Progr. N° 110 Transport emissions of C_6H_6 by mode

UNDERLYING DEFINITIONS

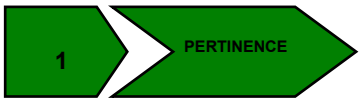
Definition

The indicator measures the emissions of benzene (C_6H_6). Benzene is a cancerogenous substance contained in fuels and currently benzene is emitted whit exhausted gases of the motor vehicles.

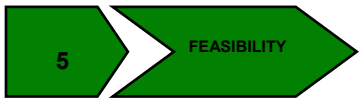
Unit of Measurement

[t/a]

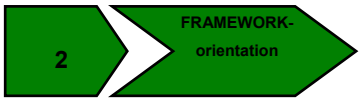
CRITERIA EVALUATION



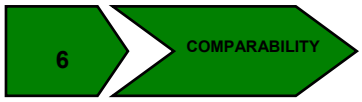
The indicator measures one of the most harmful pollutant for the human health.



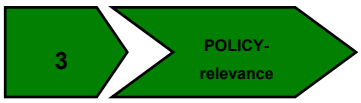
There are a lot of data sources which allow the analysis.



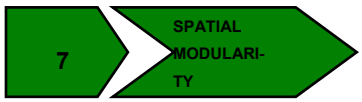
The indicator is validated by numerous international framework.



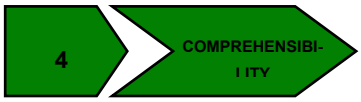
Comparability is good.



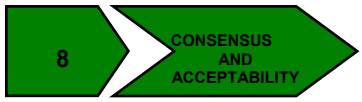
The indicator supplies information on the air quality and allows to implement and to evaluate specific policies.



Indicator spatial modularity is good.



The indicator is easy comprehensible and it uses a standard unit of measurement.



The indicator is validated by numerous sectorial studies.

THEMATIC CLASSIFICATION

Group

Group I – Environmental impact of transport (Environment)

DPSIR

D

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator is a valid signal of the pressures on ecosystems and on public health due to the transport activities. Limitations: the availability of data is extremely heterogenous, because of different methodologies are used and so the comparability is not good.

Comments

The correct geographical scale can be obtained according to data availability.

Progr. N° 201 Land take by transport infrastructure and settlement areas

UNDERLYING DEFINITIONS

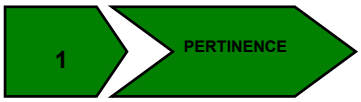
Definition

Simple indicator; it can be calculated for NUTS 3 areas.
The correct land use and the knowledge of the limited availability of spaces, above all in the alpine region, are important aspects that have to be considered for the right formulation of policies.

Unit of Measurement

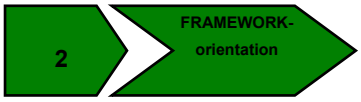
[ha]

CRITERIA EVALUATION

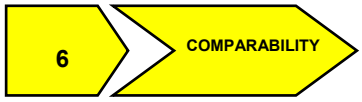


The indicator characterizes the impact of infrastructures of transport and the productive activities on the ecosystems and the human activities.

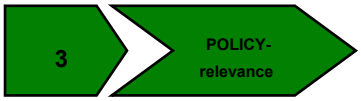
The calculation of the indicator does not seem too difficult, but it requires a long analysis.



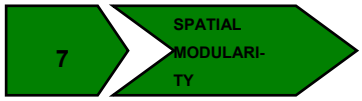
The indicator is used and calculated by a lot of institutes and environmental agencies.



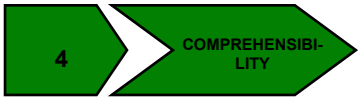
The comparability of the indicator depends on the method used for the analysis.



The indicator measures an important aspect reffered to the territorial policies.



Spatial modularity is good.



The indicator is expressed in simple units of measurement.

The indicator is validated by numerous sectorial studies and it is calculated by a lot of environmental agencies in the alpine space.

THEMATIC CLASSIFICATION

Group

Group II – Demand, accessibility and spatial planning (Organisation of transport)

DPSIR

P

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi

Strengths & Weaknesses

The indicator represents an effective measurement of the use and the exploitation of the land. Approximately 50% of the surface used for settlements and transport activities is covered by cement but also the other parts of surface are affected by impacts caused by the anthropic influences. The increase of the indicator value is moreover an index of a continuous traffic increase and of a crescent use and exploitation of the resources.
For a right interpretation it can be useful consider a local level.

Comments

Indicator variants:

Land take by transport infrastructure and settlement areas increase, per year [ha/inhabitant].

Land take by transport infrastructure and settlement areas per inhabitant [ha/inhabitant] ("territory efficiency").

Land take by transport infrastructure and settlement areas/reference area [%].

Progr. N° 205 Modal split, passenger traffic

UNDERLYING DEFINITIONS

Definition

The indicator explains the division of the quotas between the private road motorized traffic and the public transits (rail and road). The single performance is referred to the total performance (passenger-Kilometers).

Unit of Measurement

[passenger- Kilometers / passenger- Kilometers] by mode, expressed in (%)

CRITERIA EVALUATION

1 PERTINENCE

The indicator is very important in order to understand the division of the passenger traffic towards sustainable mobility systems.

2 FRAMEWORK-orientation

The indicator is scientifically founded and it is used in many mobility analysis.

3 POLICY-relevance

The indicator is an ideal measurement for the definition of modal splitting stategies.

4 COMPREHENSIBI-LITY

The indicator is synthetic and clear.

5 FEASIBILITY

The indicator requires many datas but it is easily calculable.

6 COMPARABILITY

The indicator is comparable for values of different regions and for different time series.

7 SPATIAL MODULARI-TY

Spatial modularity is good.

8 CONSENSUS AND ACCEPTABILITY

The indicator is validated by numerous sectorial studies and it is calculated by a lot of mobility agencies.

THEMATIC CLASSIFICATION

Group

Group II – Demand, accessibility and spatial planning (Organisation of transport)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Caf/UST: Indicatori quali strumenti di condotta strategica della politica

Strengths & Weaknesses

It is possible to calculate, through historical series, the percentages of division of the transport demand between road and railroad. However a precise and punctual collection of the necessary data for the analysis appears difficult.

Comments

The indicator reference area can be the national or the regional scale (it depends on the data available). The indicator is in fact not directly linkable to a more specific area.

Progr. N° 206 Modal split, freight traffic

UNDERLYING DEFINITIONS

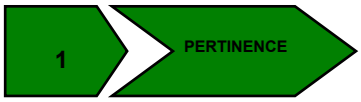
Definition

The indicator explains the division of the quotas between the freight traffic (rail and road) as the division of the freight transport performances (rail and road) in the geographic area considered.

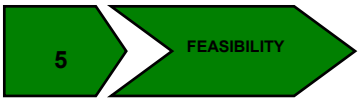
Unit of Measurement

[tons- Kilometers / tons- Kilometers] by mode, expressed in (%)

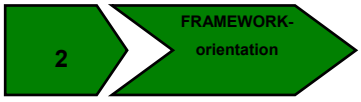
CRITERIA EVALUATION



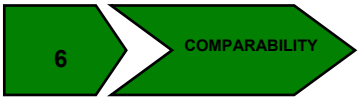
The indicator is very important in order to understand the division of the freight traffic towards sustainable mobility systems.



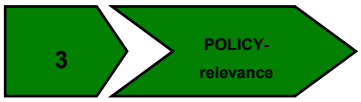
The indicator requires many data but it is easily calculable.



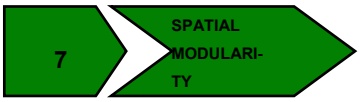
The indicator is scientifically founded and it is used in many mobility analysis.



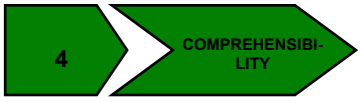
The indicator is comparable for values of different regions and for different time series.



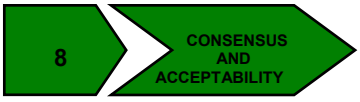
The indicator is an ideal measurement for the definition of modal splitting stategies.



The spatial modularity is good.



The indicator is synthetic and clear.



The indicator is validated by numerous sectorial studies and it is calculated by a lot of mobility agencies.

THEMATIC CLASSIFICATION

Group

Group II – Demand, accessibility and spatial planning (Organisation of transport)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Caf/UST: Indicatori quali strumenti di condotta strategica della politica

Strengths & Weaknesses

The indicator seems extremely useful in order to provide an immediate vision about the freight transport and about the “competition” between road and railroad.
However a precise and punctual collection of the necessary data for the analysis appears difficult.

Comments

The indicator reference area can be the national or the regional scale (it depends on the data available). The indicator is in fact not directly linkable to a more specific area.

Progr. N° 210 Transalpine total tonnage, per year

UNDERLYING DEFINITIONS

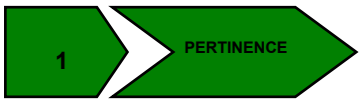
Definition

The indicator measures the total annual tonnage crossed through the main alpine pass (it is considered a subdivision between road and rail).

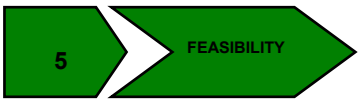
Unit of Measurement

[t/a]

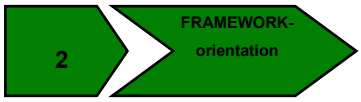
CRITERIA EVALUATION



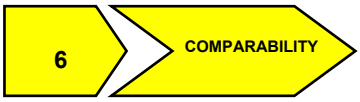
The indicator measures an important aspect referred to the alpine traffics and to the exchanges trades.



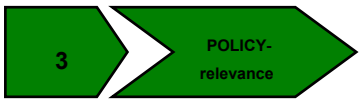
Many campaigns of surveys are being implemented even if data can not be always coherent.



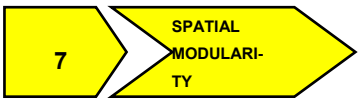
The indicator is included in many important lists of indicators on traffic and atmosphere.



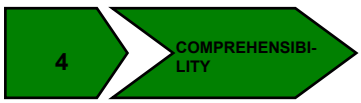
Indicator comparability is linked to the data collection homogeneity.



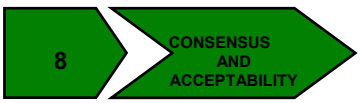
The indicator can be considered in the control and management policy formulation referred to the freight traffics. The transported tons, moreover, are not directly linked to the number of trips.



Spatial modularity is not immediate and always it must be justified.



The indicator is synthetic and clear.



The indicator is validated by numerous sectorial alpine studies and it is calculated by a lot of mobility agencies.

THEMATIC CLASSIFICATION

Group

Group II – Demand, accessibility and spatial planning (Organisation of transport)

DPSIR

D

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi

Strengths & Weaknesses

The indicator provides a clear vision about the freight transport through the Alps, even if it is difficult to distinguish between intra-alpine transports and extra-alpine transport (the analysis is referred only to the main alpine pass; see comments box). Moreover the analysis could consider only the north-south routes. For the east-west routes only traffics between Italy and France can be studied.

Comments

Only the following passes can be considered: Ventimiglia, Monginevro, Moncenisio, Fréjus, Monte Bianco (F); Gran San Bernardo, Sempione, San Gottardo, San Bernardino (CH); Resia, Brennero, Felbertauern, Tauern, Schoberpass, Semmering, Wechsel, Tarvisio (A).

Indicator variants:

Trends in Total tonnage crossed through the main alpine pass by road and railroad.

Progr. N° 232 In/out tonnage by railroad, by total modes

UNDERLYING DEFINITIONS

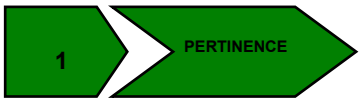
Definition

The indicator measures in/out tons (railroad sector) reffered to the total modes (NUTS 2 areas).

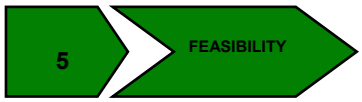
Unit of Measurement

[t/a]

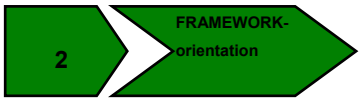
CRITERIA EVALUATION



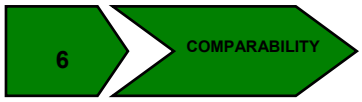
The indicator measures an important aspect referred to the traffics.



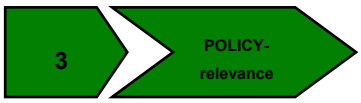
Feasibility is good (many data are required).



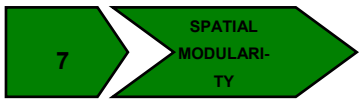
The indicator is used in national statistics surveys.



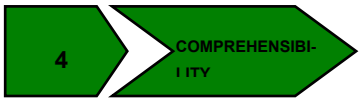
Indicator comparability requires efficient analysis.



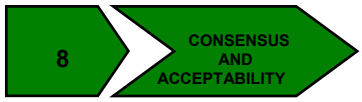
The indicator can be considered in the control and management policy formulation referred to the freight traffics.



Spatial modularity is good.



The indicator is synthetic and clear.



The indicator is validated by numerous sectorial national studies.

THEMATIC CLASSIFICATION

Group

Group II – Demand, accessibility and spatial planning (Organisation of transport)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

ISTAT – indicatori regionali di contesto chiave e variabili di rottura

Strengths & Weaknesses

The indicator provides a clear vision about the freight regional traffics. The transported tons, moreover, are not directly linked to the number of passages.

Comments

Progr. N° 234 In/out tonnage by road, by total modes

UNDERLYING DEFINITIONS

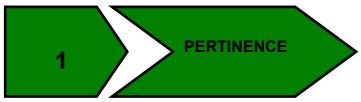
Definition

The indicator measures in/out tons (road sector) reffered to the total modes (NUTS 2 areas).

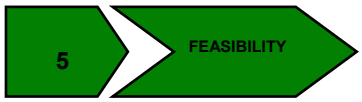
Unit of Measurement

[t/a]

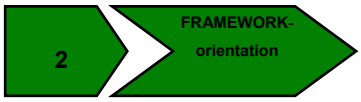
CRITERIA EVALUATION



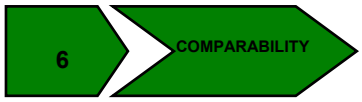
The indicator measures an important aspect referred to the traffics.



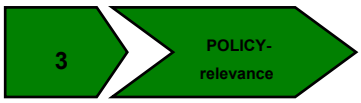
Feasibility is good (many data are required).



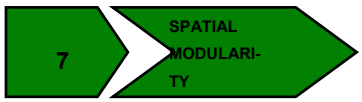
The indicator is used in national statistics surveys.



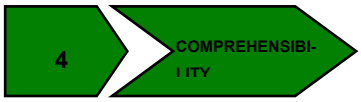
Indicator comparability requires efficient analysis.



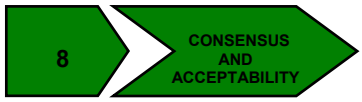
The indicator can be considered in the control and management policy formulation referred to the freight traffics.



Spatial modularity is good.



The indicator is synthetic and clear.



The indicator is validated by numerous sectorial national studies.

THEMATIC CLASSIFICATION

Group

Group II – Demand, accessibility and spatial planning (Organisation of transport)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

ISTAT – indicatori regionali di contesto chiave e variabili di rottura

Strengths & Weaknesses

The indicator provides a clear vision about the freight regional traffics. The transported tons, moreover, are not directly linked to the number of passages.

Comments

Progr. N° 301 Cumulative infrastructure length built every year

UNDERLYING DEFINITIONS

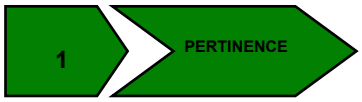
Definition

The indicator measures the Km of new railway and road infrastructure built every year (considering the highway and the state roads too). The calculation can be reported to regional level NUTS 2, or NUTS 3 level.

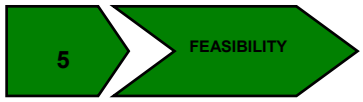
Unit of Measurement

[Km/a]

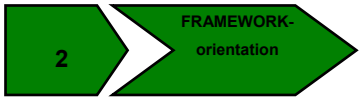
CRITERIA EVALUATION



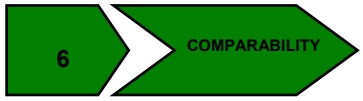
The indicator measures one of the main transport factors of pressure



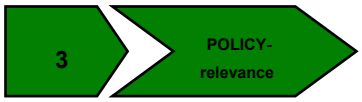
The indicator is easily calculable.



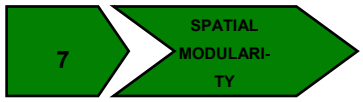
The indicator is used and calculated in international analysis.



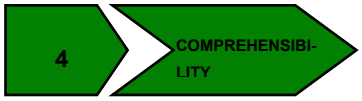
The indicator is comparable for values of different regions and for different time series.



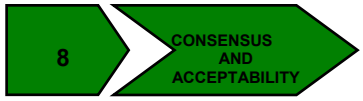
The indicator is directly linked to construction and expansion of the transport nets policies.



The indicator is easily calculable for different areas.



The indicator is easy and comprehensible.



The indicator is widely accepted in international analysis.

THEMATIC CLASSIFICATION

Group

Group III – Transport infrastructure use (Infrastructure)

DPSIR

P*

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Environmental Protection Agency (EPA)

Strengths & Weaknesses

The indicator provides a concrete measure of the impacts referred to infrastructure insertion on the environment (transport infrastructure damage existing vegetation an alter the hydrology) but also on the economic development.
Limitation: the simple numerical value could refer to Km of new various infrastructures (with different infrastructural characteristics and therefore with different effects).

Comments

Progr. N° 303 **Investments in trasport infrastructure, per capita and by mode**

UNDERLYING DEFINITIONS

Definition

The indicator measures investments in transport infrastructures aiming to estimate the division per capita and by mode. The analysis has to consider public investments and also private investments in transport infrastructures.

Unit of Measurement

[€/a]

CRITERIA EVALUATION

1 PERTINENCE

The indicator measures mobility infrastructures expenses and so it gives an immediate perception of the mobility investments.

2 FRAMEWORK-orientation

The indicator is used and calculated in international analysis.

3 POLICY-relevance

The indicator supplies information on the financial policies.

4 COMPREHENSIBI-I ITY

The indicator is easy and comprehensible.

5 FEASIBILITY

The indicator is easily calculable.

6 COMPARABILITY

The indicator has a good comparability if it's well implemented.

7 SPATIAL MODULARI-TY

The indicator is easily calculable for different areas.

8 CONSENSUS AND ACCEPTABILITY

The indicator is widely accepted in international analysis.

THEMATIC CLASSIFICATION

Group

Group III – Transport infrastructure use (Infrastructure)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator is effective in finding investments in transport infrastructure and consequently it can measure their expansion. However data collection process has to be conduct carefully.

Comments

It can be difficult finding relative data about private investments, a first analysis can consider only public investments.
Reference area: NUTS 1 or NUTS 2.

Progr. N° 306 Road density in terms of population

UNDERLYING DEFINITIONS

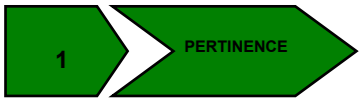
Definition

The indicator expresses the total length of the road infrastructure in terms of population. The total road network would have to comprise: a) highways, b) main or national roads c) secondary or regional roads and eventually d) urban roads and e) rural roads; possible reference: NUTS 3 areas.

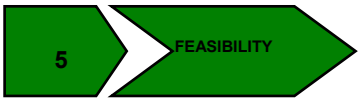
Unit of Measurement

[Km/ab]

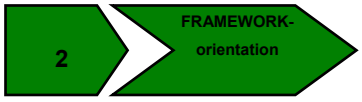
CRITERIA EVALUATION



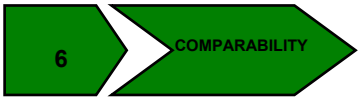
The indicator measures one of the most important factors referred to the generation of traffic and to the mobility of the regions in object.



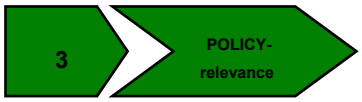
The indicator feasibility is elevated (easy data collection).



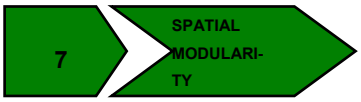
The indicator is used and calculated in many mobility analysis.



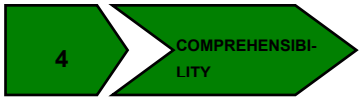
Indicator comparability is good (easy formulation of the indicator).



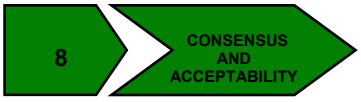
The indicator is very useful to implemet regional development policies and to manage the mobility.



Spatial modularity is good.



The indicator is easy and comprehensible.



The indicator is widely accepted in international analysis.

THEMATIC CLASSIFICATION

Group

Group III – Transport infrastructure use (Infrastructure)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM (REDI: PERFORMANCE INDICATORS FOR TRANSPORT)

Strengths & Weaknesses

The indicator allows to point out the effective presence of road infrastructures in terms of population, improving the simple length calculation.

Comments

Progr. N° 307 Road density in terms of land area

UNDERLYING DEFINITIONS

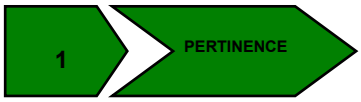
Definition

The indicator expresses the total length of the road infrastructure in terms of land area.
The total road network would have to comprise: a) highways, b) main or national roads c) secondary or regional roads and eventually d) urban roads and e) rural roads; possible reference: NUTS 3 areas.

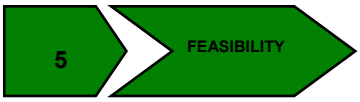
Unit of Measurement

[Km/Km^2]

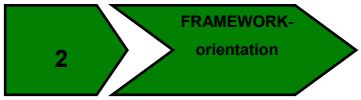
CRITERIA EVALUATION



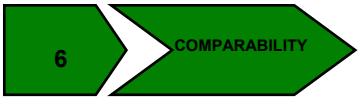
The indicator measures one of the most important factors referred to the generation of traffic and to the mobility of the regions in object.



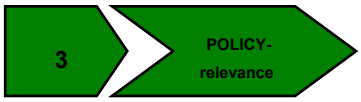
The indicator feasibility is elevated (easy data collection).



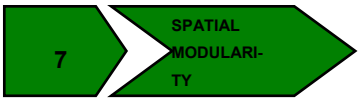
The indicator is used and calculated in many mobility analysis.



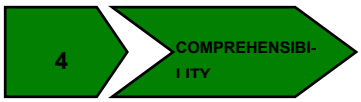
The indicator comparability is good (easy formulation of the indicator).



The indicator is very useful to implemet regional development policies and to manage the mobility.



The spatial modularity is good.



The indicator is easy and comprehensible.

The indicator is widely accepted in international analysis.

THEMATIC CLASSIFICATION

Group

Group III – Transport infrastructure use (Infrastructure)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM (REDI: PERFORMANCE INDICATORS FOR TRANSPORT)

Strengths & Weaknesses

The indicator allows to point out the effective presence of road infrastructures in terms of land area, improving the simple length calculation.

Comments

Progr. N° 308 Rail lines density in terms of population

UNDERLYING DEFINITIONS

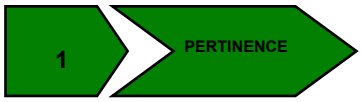
Definition

The indicator expresses the total length of the rail infrastructure in terms of population. The calculation would have to comprise the ordinary lines and also the high speed lines.
Possible reference: NUTS 3 areas.

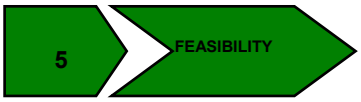
Unit of Measurement

[Km/ab]

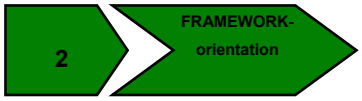
CRITERIA EVALUATION



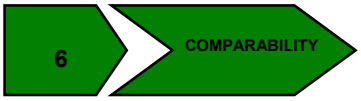
The indicator measures one of the most important factors referred to the generation of traffic and to the mobility of the regions in object.



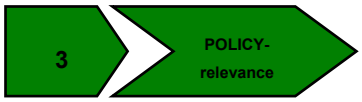
The indicator feasibility is elevated (easy data collection).



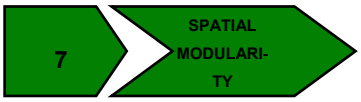
The indicator is used and calculated in many mobility analysis.



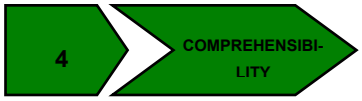
The indicator comparability is good (easy formulation of the indicator).



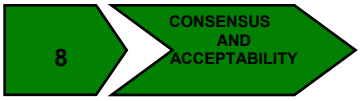
The indicator is very useful to implemet regional development policies and to manage the mobility.



The spatial modularity is good.



The indicator is easy and comprehensible.



The indicator is widely accepted in international analysis.

THEMATIC CLASSIFICATION

Group

Group III – Transport infrastructure use (Infrastructure)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM (REDI: PERFORMANCE INDICATORS FOR TRANSPORT)

Strengths & Weaknesses

The indicator allows to point out the effective presence of rail infrastructures in terms of population, improving the simple length calculation.

Comments

Progr. N° 309 Rail lines density in terms of land area

UNDERLYING DEFINITIONS

Definition

The indicator expresses the total length of the rail infrastructure in terms of land area. The calculation would have to comprise the ordinary lines and also the high speed lines.
Possible reference: NUTS 3 areas.

Unit of Measurement

[Km/Km^2]

CRITERIA EVALUATION

1 PERTINENCE

The indicator measures one of the most important factors referred to the generation of traffic and to the mobility of the regions in object.

2 FRAMEWORK-orientation

The indicator is used and calculated in many mobility analysis.

3 POLICY-relevance

The indicator is very useful to implement regional development policies and to manage the mobility.

4 COMPREHENSIBI-LITY

The indicator is easy and comprehensible.

5 FEASIBILITY

The indicator feasibility is elevated (easy data collection).

6 COMPARABILITY

The indicator comparability is good (easy formulation of the indicator).

7 SPATIAL MODULARI-TY

The spatial modularity is good.

8 CONSENSUS AND ACCEPTABILITY

The indicator is widely accepted in international analysis.

THEMATIC CLASSIFICATION

Group

Group III – Transport infrastructure use (Infrastructure)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM (REDI: PERFORMANCE INDICATORS FOR TRANSPORT)

Strengths & Weaknesses

The indicator allows to point out the effective presence of rail infrastructures in terms of land area, improving the simple length calculation.

Comments

Progr. N° 401 Heavy weight traffic taxes per kilometre

UNDERLYING DEFINITIONS

Definition

Traffic taxes are proposed in order to maximize the economic development and the social-welfare. Taxes are also proposed for the reduction of the transport impacts together with the maintenance of the benefits. There is wide consensus regarding the heavy transport sector: 'problems referred to the correct maintenance of the external costs have a significant importance.

Unit of Measurement

[€/Km]

CRITERIA EVALUATION

1 PERTINENCE

The indicator allows to measure the practised taxes on the heavy weight traffic sector.

2 FRAMEWORK-orientation

The indicator is referred to the project MONITRAF aims.

3 POLICY-relevance

The indicator is of extreme importance for the control of the traffic policies and for the development of laws about the traffic regulation.

4 COMPREHENSIBI-LITY

The indicator has a simple formulation and uses a meaningful unit of measurement.

5 FEASIBILITY

The indicator requires some elaborations but the data availability is good.

6 COMPARABILITY

Comparability is good.

7 SPATIAL MODULARI-TY

Spatial modularity is good.

8 CONSENSUS AND ACCEPTABILITY

The indicator is validated by numerous sectorial alpine studies.

THEMATIC CLASSIFICATION

Group

Group IV – Cost and price of transport services (Pricing and regulation)

DPSIR

R*

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM e rapporto Basler+Partner WP5 MONITRAF

Strengths & Weaknesses

Nowadays in Europe, with the exclusion of Switzerland, great part of the external costs is covered simply through fuels duties and heavy weight traffic taxes. These policies reflect, where they exist, only economic purposes. Indicator processing could therefore results difficult and its interpretation could therefore results not easy.

Comments

The right geographical scale can be obtained according to data availability.

Progr. N° 402 Transport prices

UNDERLYING DEFINITIONS

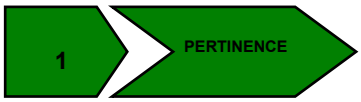
Definition

The indicator measures transport prices, it considers transport prices dynamics (passenger and freight traffic) by mode. The time evolution of this important “driver” allows to study the transport questions and the modal split. As an example a transport prices decrease can involve modal shift.

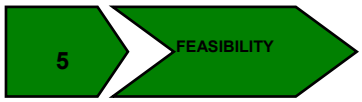
Unit of Measurement

[-], (price index)

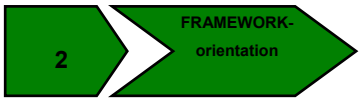
CRITERIA EVALUATION



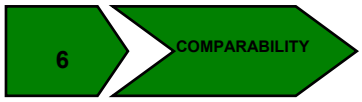
The indicator measures the traffic effects on the domestic economy.



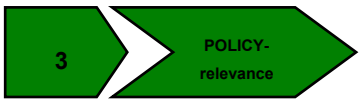
The indicator requires a lot of data but the feasibility is good.



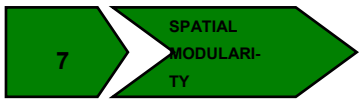
The indicator is widely used and it is reported in numerous international framework.



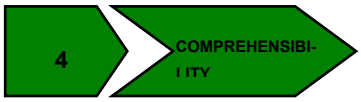
Comparability is good.



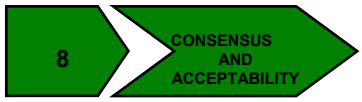
The indicator is extremely useful in order to estimate prices dynamics and to estimate the mobility demand.



Spatial modularity is good.



The indicator is clear.



The indicator is validated by numerous international studies.

THEMATIC CLASSIFICATION

Group

Group IV – Cost and price of transport services (Pricing and regulation)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator allows to measure transport costs and, by historical series, time evolution.
It is necessary to analyze this indicator together with indicators about external costs and indicators about fuels prices.

Comments

Possible reference: NUTS 2 areas.

Progr. N° 403 Fuel prices and taxes

UNDERLYING DEFINITIONS

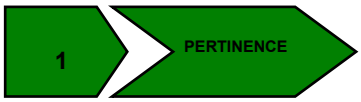
Definition

The indicator measures fuels taxes and prices trend, together with the fiscal evolution in the absolute levels of the prices and the differences between petrol and diesel and fuels incentives for fuels without lead or with low sulfur tenor. It measures one of the main government instruments that can modify the transports prices.

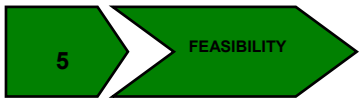
Unit of Measurement

[€/l]

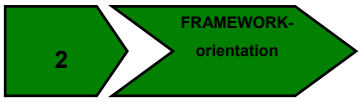
CRITERIA EVALUATION



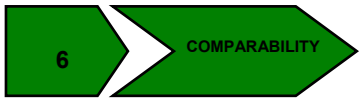
The indicator is an important signal of the control on fuels prices and therefore on the consumption.



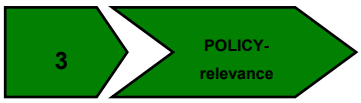
The indicator requires a lot of data but the feasibility is good.



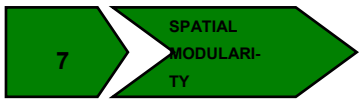
The indicator is widely used and it is reported in numerous international framework.



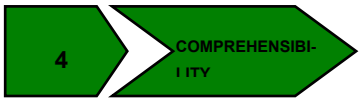
If the calculation of the indicator is carried out in rigorous way the comparability is possible and it is founded.



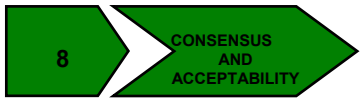
The indicator is an important signal of the policy control on transport evolution.



The indicator can be used for regional analysis, even if the data is reported to national State level.



The indicator is clear.



The indicator is validated by numerous international studies.

THEMATIC CLASSIFICATION

Group

Group IV – Cost and price of transport services (Pricing and regulation)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator allows to measures transport costs. Data are wide available to European level.

Comments

Possible reference: national State level.

Progr. N° 411 Average rail tariff, Freight (€/ton-Km)

UNDERLYING DEFINITIONS

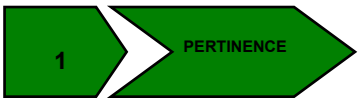
Definition

The indicator measures the average rail tariff as sum of the total rail freight transport revenue divided by total rail freight tonne-kilometers. A freight tonne-kilometer is the movement of one tonne of goods by rail over a distance of one kilometer. Possible reference: NUTS 2 areas.

Unit of Measurement

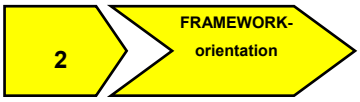
[€/tonne-Km]

CRITERIA EVALUATION

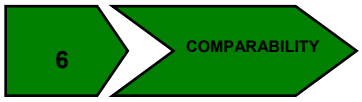


The indicator is an important signal of the control on rail shipments and therefore on the mobility demand.

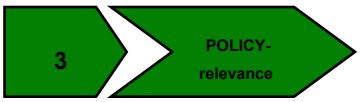
The indicator requires a lot of data.



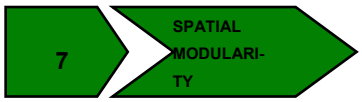
The inidicator scientifically founded but not still considered in many international framework.



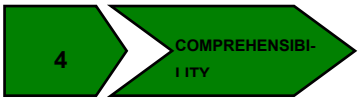
Comparability is good.



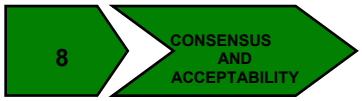
The indicator allows to measures the tariff pressure and to calibrate the rail shipments management policies.



Spatial modularity is good.



The indicator, even if it is in presented in an elaborated way, remains of clear ad feasible.



The indicator is validated by numerous international studies.

THEMATIC CLASSIFICATION

Group

Group IV – Cost and price of transport services (Pricing and regulation)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

REDI: PERFORMANCE INDICATORS FOR TRANSPORT

Strengths & Weaknesses

The indicator supplies a easy panoramic on the tendencies of the transport rates through the Alps (it can be difficult to distinguish the intra-alps transports from extra-alps transport). Weaknesses are referred to the gathering of the necessary data, data are always difficult to obtain (competition between transport companies). Data available however results strongly aggregate.

Comments

Progr. N° 501 EURO 4 (and following) vehicles/Total vehicle fleet

UNDERLYING DEFINITIONS

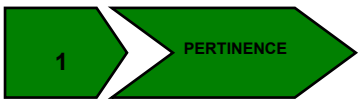
Definition

The indicators measures the proportion of the total vehicle fleet that respects the more recent emission standards. Emissions of pollutant are in fact closely connected, in the road vehicle travel sector, to the fuel combustion modalities; the use of appropriate technologies also reduces remarkablly the emission.

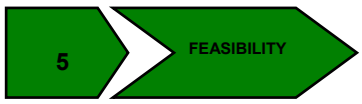
Unit of Measurement

[n° vehicles/n° vehicles], expresses in (%)

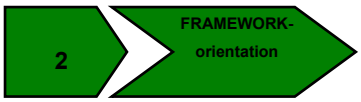
CRITERIA EVALUATION



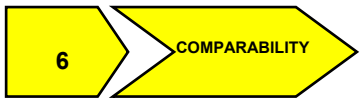
The indicator measures a factor (closely connected with the age of the vehicle fleet) that influences indirectly emissions levels.



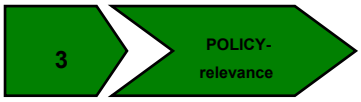
The indicator, at least at an approximated level of analysis, is feasible without excessive difficulties.



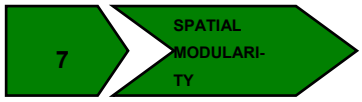
The indicator is included in many important international lists of indicators on traffic and atmosphere.



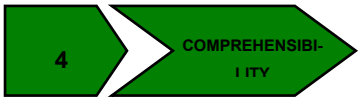
The comparability is limited by the accuracy of data gathering.



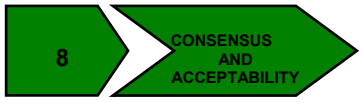
The indicator can be considered in the control and management policy formulation referred to the transportation.



Spatial modularity is good.



The indicator is simple and clear.



The indicator is validated by numerous international analysis.

THEMATIC CLASSIFICATION

Group

Group V – Technology and efficiency of transport (Technology)

DPSIR

D

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator can present also important information about cars market.

Comments

The right geographical scale can be obtained according to data availability.
Possible reference area (definite analysis): NUTS 3.

Progr. N° 503 Emissions of CO_2 by passenger-km and by tonne-km

UNDERLYING DEFINITIONS

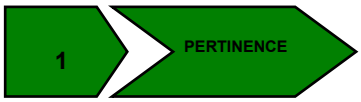
Definition

The indicator measures carbon dioxide (CO_2) emissions divided by passenger-km and tonne-km. it is directly connected to the air quality and to the spread of motor vehicles with smaller environmental impact.

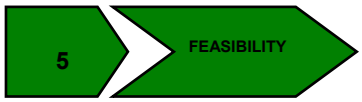
Unit of Measurement

[g CO_2/passenger-km]; [g CO_2/tonne-km]

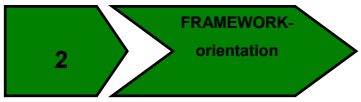
CRITERIA EVALUATION



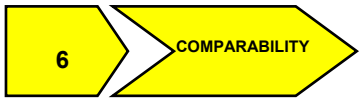
The indicator measures the emissions in the atmosphere of one of the most dangerous pollutant for the atmosphere.



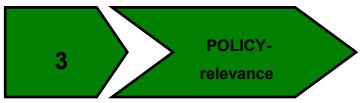
The indicator requires a lot of data but the feasibility is good.



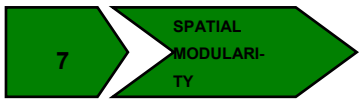
The indicator is included in many important international lists of indicators on traffic and atmosphere.



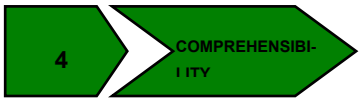
The comparability is good if the indicator processing is accurate.



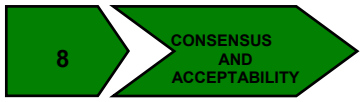
The indicator can be considered in the control and management policy formulation referred to the transportation.



Spatial modularity is good.



The indicator is easy comprehensible and it uses a standard unit of measurement.



The indicator is validated by numerous international analysis.

THEMATIC CLASSIFICATION

Group

Group V – Technology and efficiency of transport (Technology)

DPSIR

D

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator allows to estimate the traffic pressures and impacts on the air quality.

Comments

Possible reference area: NUTS 3 areas (for different types of vehicle fleet).

Progr. N° 509 Load factors for freight transport

UNDERLYING DEFINITIONS

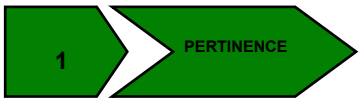
Definition

The indicator measures the degree of occupation of freight vehicles, by typology (trailer trucks, trains, etc.). Increasing the load factor it is possible to transport the same number of goods with less vehicles and therefore with a saving in term of energetic consumptions and impacts on the man and the ecosystems.

Unit of Measurement

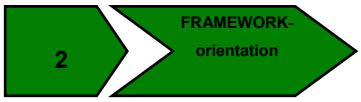
[t transported /t transportable by vehicle type], expressed as (%)

CRITERIA EVALUATION

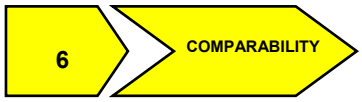


The indicator is directly linked to transport efficiency and therefore to traffic impacts.

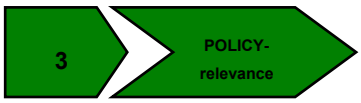
Indicator feasibility is linked to esteem.



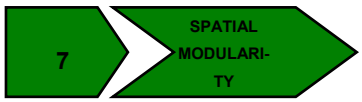
The indicator is reported in almost all the international frameworks.



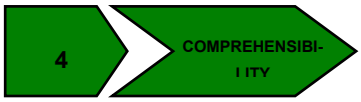
Indicator comparability is linked to how the indicator is processed.



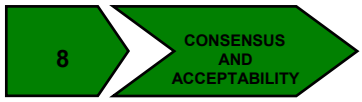
The indicator is already used in some alpine Countries to implement policies about heavy traffic control.



Spatial modularity is good.



The indicator is immediately comprehensible.



The indicator is very important to control transport policies.

THEMATIC CLASSIFICATION

Group

Group V – Technology and efficiency of transport (Technology)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator measures a simple but meaningful issue, not directly connected to the technological efficiency but to the use of vehicles. Data collecting is often not precise, being generally based on estimations.

Comments

An effective indicator calculation can be obtained in reference to precise corridors and certain vehicle types (i. e. trailer truck/ freight train).

Progr. N° 516 Cars/inhabitants

UNDERLYING DEFINITIONS

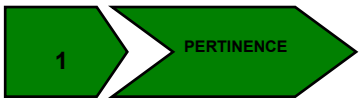
Definition

The indicator expresses the relationship between the number of cars and the population. A car is a whichever motor-vehicle , with the exception of the motor-vehicles, for the transport of passengers with not more than 9 places (included the driver). Possible ref. area: NUTS 3.

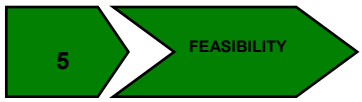
Unit of Measurement

[n° cars/inhabitant]

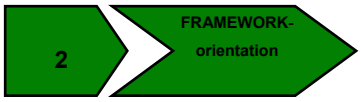
CRITERIA EVALUATION



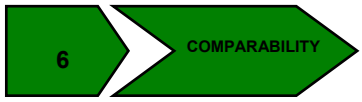
The indicator is very important for the interpretation of personal mobility.



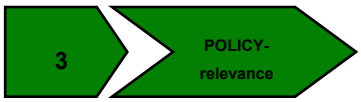
The indicator is commonly calculated by many research institutes and the availability of data is wide.



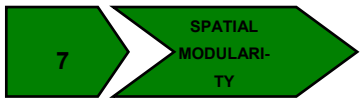
The indicator is adopted by all the international lists of mobility indicators.



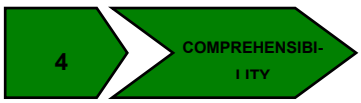
Comparability is guaranteed (wide data availability).



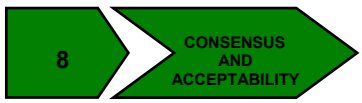
The indicator is extremely useful to implement policies about sustainable mobility.



Spatial modularity is good.



The indicator is simple and comprehensible.



The pointer is validated by many studies performed by international institutes.

THEMATIC CLASSIFICATION

Group

Group V – Technology and efficiency of transport (Technology)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM

Strengths & Weaknesses

Base indicator used to estimate the effects of personal traffic on a reference area.

Comments

Progr. N° 601 Integrated transport and environment strategies

UNDERLYING DEFINITIONS

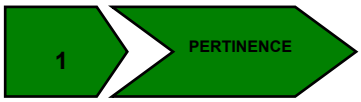
Definition

The indicator points out if the reference NUTS 2 area applies an integrated strategy in the field of transport and atmosphere. Such strategies can consist in integrated territorial planning, in management of the modal split, in measures on the atmosphere or about safety.

Unit of Measurement

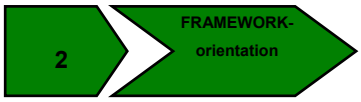
[n° applied integrated strategies]

CRITERIA EVALUATION

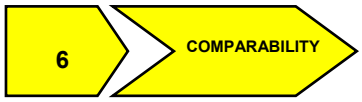


The indicator monitors a fundamental issue for the reduction of the transalpine traffic impacts.

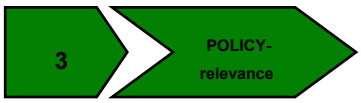
The indicator feasibility is simple, being the indicator formulated in a simple, but not too precise, formulation.



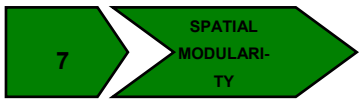
The indicator is based on European standards and it's validated by TERM project.



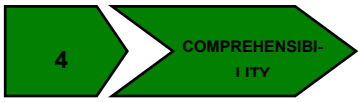
The indicator comparability is linked to a precise, but not easy, definition of the measurement unit.



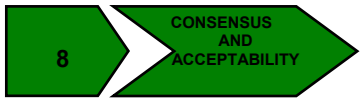
The indicator is useful to implement management policies about traffic.



Spatial modularity is good.



The indicator is expressed in a very simple way.



The indicator is based upon studies performed by European institutes.

THEMATIC CLASSIFICATION

Group

Group VI – Information and education (Behaviour)

DPSIR

R*

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator supplies information on the policies performed by the regions considered. A precise quantification of the measurement unit appears difficult.

Comments

The indicator is feasible through examples.

Progr. N° 603 National transport and environment monitoring systems

UNDERLYING DEFINITIONS

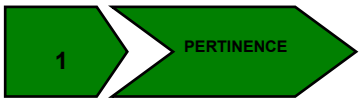
Definition

The indicator points out if reference NUTS 2 area puts into effect monitoring systems on transports and atmosphere. Such systems can consist in specific reports on transports and atmosphere or the inclusion of the transport issues in the reports on the state of the atmosphere.

Unit of Measurement

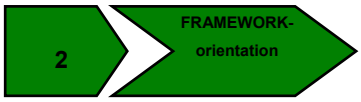
[n° and type implemented monitoring systems]

CRITERIA EVALUATION

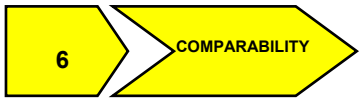


The indicator monitors the effort of the various regions in transport studies.

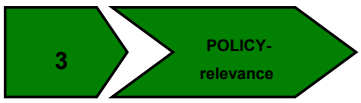
The indicator feasibility is simple, being the indicator formulated in a simple, but not too precise, shape.



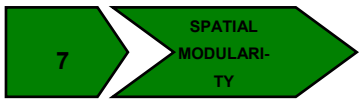
The indicator is based on European standards and it's validated by TERM project.



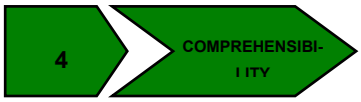
The indicator comparability is linked to a precise, but not easy, definition of the measurement unit.



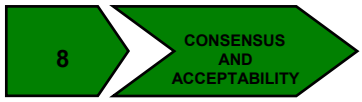
The indicator monitors support issues for the formulation of good policies.



Spatial modularity is good.



The indicator is expressed in a very simple way.



The indicator is based upon studies performed by European institutes.

THEMATIC CLASSIFICATION

Group

Group VI – Information and education (Behaviour)

DPSIR

R*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator supplies information on the type of obtainable information and the type of description of traffic issues.
A precise quantification of the measurement unit appears difficult.

Comments

The indicator is feasible through examples.

Progr. N° 701 GDP per inhabitant

UNDERLYING DEFINITIONS

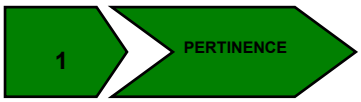
Definition

The indicator measures the value of the economic performance resulting from productive activities in a period of reference, calculated for NUTS 3 areas. It allows, in a balanced development context for the population and for sustainable development, to estimate also an economically balanced development for weak areas..

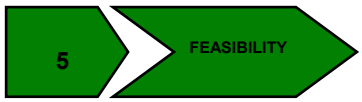
Unit of Measurement

[€/inhabitant]

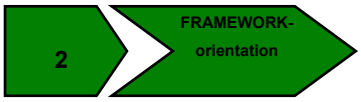
CRITERIA EVALUATION



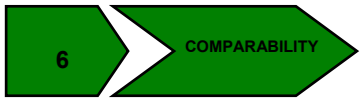
The indicator is considered standard for the measure of the economic performance of a reference area.



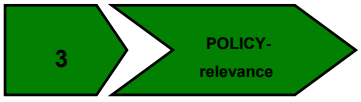
There are a lot of data bases useful to process the indicator.



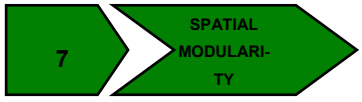
The indicator is used by many international frameworks.



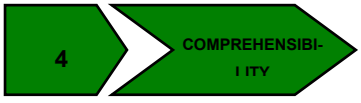
The indicator is easily comparable and it can be calculated using different time series.



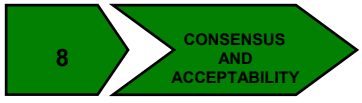
The indicator measures the life quality in the area considered and it can be considered a signal of welfare.



The spatial modularity is good.



The indicator is easily comprehensible and uses a standard unit of measurement.



The indicator is widely used and accepted.

THEMATIC CLASSIFICATION

Group

Group VII –Economic performance (Economy)

DPSIR

D

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Rapporto Basler+Partner WP5 MONITRAF, Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi

Strengths & Weaknesses

The indicator is common and diffused (economic reporting). It is necessary to consider some interpretative limitations in terms, as an example, of disparity inside of territorial units. The survey of the economic data is moreover carried out in the main centre of the enterprises, referring exclusively to such centre the produced added value also in eventual plants localizes elsewhere. For this reason it is not opportune to refer to local territorial units.

Comments

Progr. N° 708 Activity rate

UNDERLYING DEFINITIONS

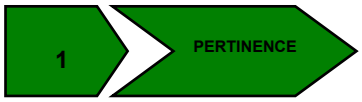
Definition

The indicator measures the number of employed in terms of the reference population (the active population of age comprised between the 15 and 64 years). As in several Countries are used divergent definitions, is advisable to use to the harmonized data Eurostat for NUTS 3 territorial units.

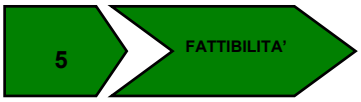
Unit of Measurement

[n° employed/ active population of age comprised between 15 and 64 years], as (%)

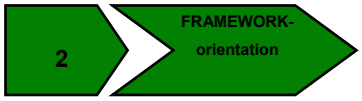
CRITERIA EVALUATION



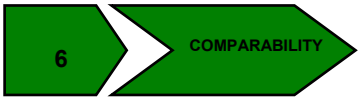
The indicator is considered as an important signal to monitor economic performances and traffic trends.



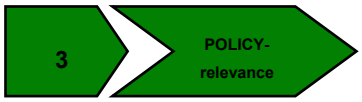
The indicator is based by data usually published by numerous research institutes.



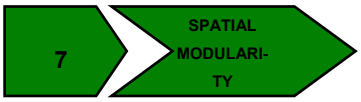
The indicator is used by many sustainability frameworks.



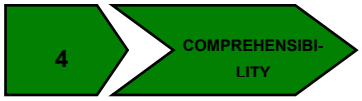
Because of the indicator is widely used and updated the comparability is guaranteed and possible for many types of analysis.



The indicator is used to control traffic limitation policies.



The spatial modularity is possible in reference to NUTS 3 areas.



The indicator is simply and used in many social and economic analysis.

The indicator is validated by numerous international studies.

THEMATIC CLASSIFICATION

Group

Group VII –Economic performance (Economy)

DPSIR

D

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi

Strengths & Weaknesses

Common and diffused indicator used for the description of the economic trend, even if the definition of the activity rate is not shared between different Countries. For the calculation the harmonized data Eurostat can be used, but they are partially based on esteem and interpolations, so there is a certain margin of uncertainty.

Comments

Indicator variants:

Trends in activity rate in terms of increase or bending percentage.

Progr. N° 716 **Road expenditure as share of GDP, per year**

UNDERLYING DEFINITIONS

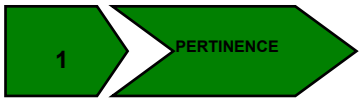
Definition

The indicator monitors the total amount of the expense for the construction of new roads and the extension of existing roads, for remaking and repair, per year expressed as percentage of GDP. Possible reference area: NUTS 3 (or NUTS 2).

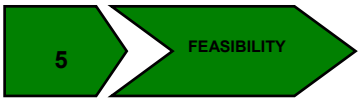
Unit of Measurement

[€/€], expressed as (%)

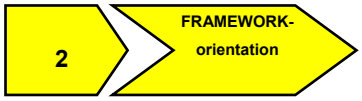
CRITERIA EVALUATION



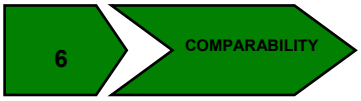
The indicator allows to estimate the economic effort referred to the road sector and to monitor the expansion of the infrastructure-net.



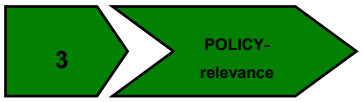
The indicator is simply feasible: data bases are quite updated.



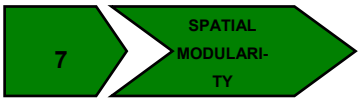
The indicator is used in many studies but it is not still inserted in international frameworks.



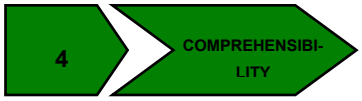
The indicator is defined in a clear way and it does not introduce comparability problems.



The indicator is important to control transport policies.



Spatial modularity is good.



The indicator provides essential information in a synthetic way.

The indicator is validated by many international institutes.

THEMATIC CLASSIFICATION

Group

Group VII –Economic performance (Economy)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

REDI: PERFORMANCE INDICATORS FOR TRANSPORT

Strengths & Weaknesses

The indicator is easily calculable. It is however necessary to consider some interpretative limitations in terms, as an example, of disparity inside of the territorial units. The survey of the economic data is moreover carried out in the main centre of the enterprises, referring exclusively to such centre the produced added value also in eventual plants localizes elsewhere. For this reason it is not opportune to refer to local territorial units.

Comments

Progr. N° 724 Transport sector persons in employment

UNDERLYING DEFINITIONS

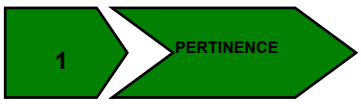
Definition

The indicator monitors the number of employed in transport sector (NACE sections 60, 61 and 62 (*)). Such number is very useful to monitor the transport market. Possible reference area: NUTS 3.

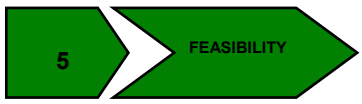
Unit of Measurement

[n° Transport sector persons in employment]

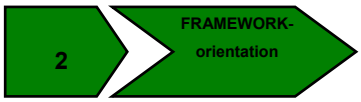
CRITERIA EVALUATION



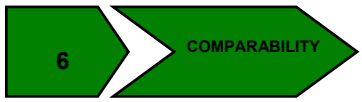
The indicator is very useful to evaluate transport sector.



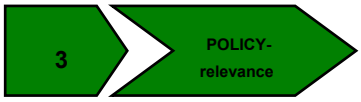
The indicator is based upon data collected by many economic institutes.



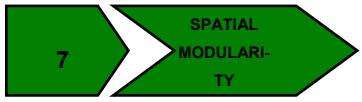
The indicator is used by many social-economic frameworks.



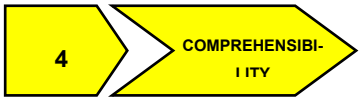
Because of the indicator is widely used and updated, the comparability is guaranteed and possible for many types of analysis.



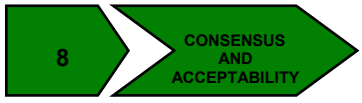
The indicator is useful to monitor transport policies.



Starting from NUTS 3 areas, the spatial modularity is good.



The indicator is detailed but easily comprehensible.



The indicator is validated by many international institutes.

THEMATIC CLASSIFICATION

Group

Group VII –Economic performance (Economy)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Benchmarking dell'offerta di trasporto delle regioni dello spazio alpino. Il ruolo della Regione piemonte

Strengths & Weaknesses

The definition of the occupation is not harmonized in Europe. The harmonized Eurostat data are partially based on esteem and interpolations, so there's a certain margin of uncertainty.

Comments

(*) Codici NACE I: 60 TRASPORTI TERRESTRI; TRASPORTI MEDIANTE CONDOTTE, 61 TRASPORTI MARITTIMI E PER VIE D'ACQUA , 62 TRASPORTI AEREI.

NACE: classificazione delle attività economiche da adottare nelle rilevazioni statistiche correnti, definita in ambito europeo ed approvata con Regolamento della Commissione n. 29/2002, pubblicato su Official Journal del 10/1/2002; (per la Svizzera: sezioni NOGA).

Progr. N° 725 Transport complementary sector persons in employment

UNDERLYING DEFINITIONS

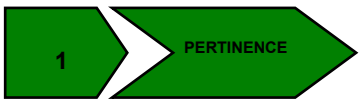
Definition

The indicator monitors the number of employed in transport complementary sector (NACE sections I 63(*)). Such number is very useful to monitor the transport market. Possible reference area: NUTS 3.

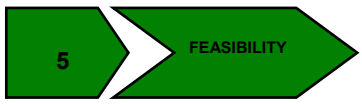
Unit of Measurement

[n° Transport complementary sector persons in employment]

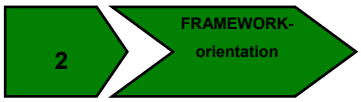
CRITERIA EVALUATION



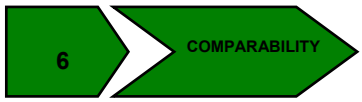
The indicator is very useful to evaluate transport sector.



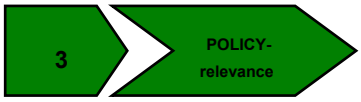
The indicator is based upon data collected by many economic institutes.



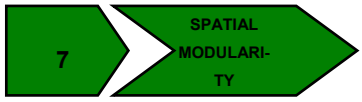
The indicator is used by many social-economic frameworks.



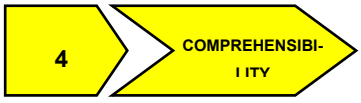
Because of the indicator is widely used and updated, the comparability is guaranteed and possible for many types of analysis.



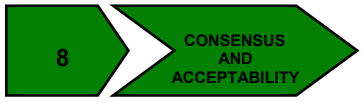
The indicator is useful to monitor transport policies.



Starting from NUTS 3 areas, the spatial modularity is good.



The indicator is detailed but easily comprehensible.



The indicator is validated by many international institutes.

THEMATIC CLASSIFICATION

Group

Group VII –Economic performance (Economy)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Benchmarking dell'offerta di trasporto delle regioni dello spazio alpino. Il ruolo della Regione piemonte

Strengths & Weaknesses

The definition of the occupation is not harmonized in Europe. The harmonized Eurostat data are partially based on esteem and interpolations, so there's a certain margin of uncertainty.

Comments

(*) Codici NACE I: 63 ATTIVITÀ DI SUPPORTO ED AUSILIARIE DEI TRASPORTI; ATTIVITÀ DELLE AGENZIE DI VIAGGI

NACE: classificazione delle attività economiche da adottare nelle rilevazioni statistiche correnti, definita in ambito europeo ed approvata con Regolamento della Commissione n. 29/2002, pubblicato su Official Journal del 10/1/2002; (per la Svizzera: sezioni NOGA).

Progr. N° 801 Residents per square meter

UNDERLYING DEFINITIONS

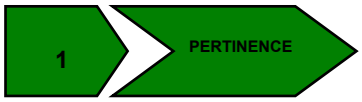
Definition

The indicator can be considered as a provider of base information for a lot of purposes. Calculation is generally carried out considering the number of inhabitants per m^2 or km^2. According to MONITRAF scopes calculation could be carried in reference to NUTS 3 areas.

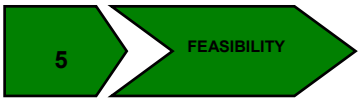
Unit of Measurement

[inhabitants/Km^2]

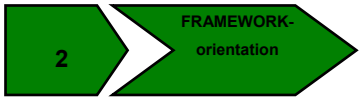
CRITERIA EVALUATION



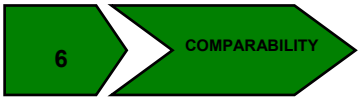
The indicator, measuring population distribution, allows to measure general impacts on traffic.



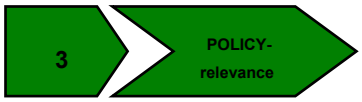
The indicator is easily implementable.



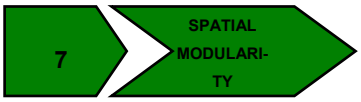
The indicator is validated by many international frameworks.



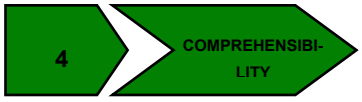
The indicator is easily comparable.



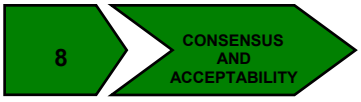
The indicator is an important signal about development and infrastructure management policies..



The indicator has a good modularity.



The indicator is easily comprehensible; it's used a standard measurement unit.



The indicator is used in a wide range of studies about spatial planning and sustainable transport.

THEMATIC CLASSIFICATION

Group

Group VIII – Cultural potential and social resources (Society)

DPSIR

D

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Rapporto Basler+Partner WP5 MONITRAF, Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi

Strengths & Weaknesses

The statistic shape of the indicator is a strength because, through a simple analysis, it allows to obtain information about various aspects linked to density. Political measures can be deducted only in reference to other indicators.

Comments

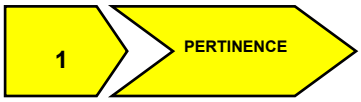
Definition

The indicator monitors the difference (in terms of surplus or deficit) between the number of births and the number of the deaths, per year. The indicator is obviously linked to fecundity rate. Possible reference area: NUTS 3.

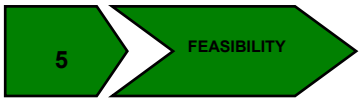
Unit of Measurement

[inhabitants]

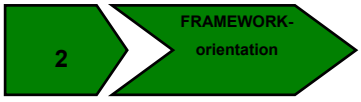
CRITERIA EVALUATION



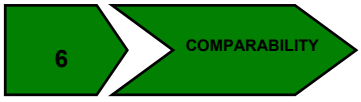
Basic indicator used in social and economic analyses not directly linked to the measurement of traffic impacts.



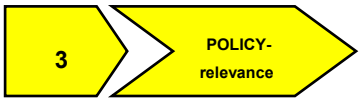
The indicator implementation is easy and precise. Data bases are easily available and the method of collection is uniform in the countries interested by the plan.



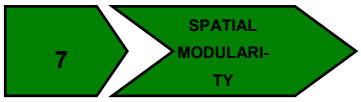
The indicator is used by many international frameworks.



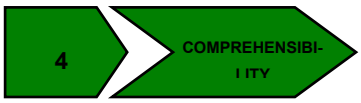
The indicator is easily comparable.



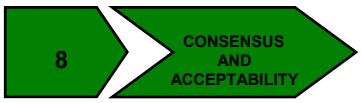
Base indicator that can lead easily to social and economic policies, than can be referred only in an indirect way to mobility policies.



Spatial modularity is good.



The indicator is simple and easily comprehensible.



The indicator is widely used and accepted.

THEMATIC CLASSIFICATION

Group

Group VIII – Cultural potential and social resources (Society)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM

Strengths & Weaknesses

Base indicator useful to the definition of demographic features.

Note

Progr. N° 806 Migration balance

UNDERLYING DEFINITIONS

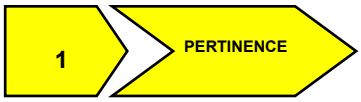
Definition

The indicator monitors the difference (in terms of surplus or deficit) between the number of registrations and cancellations at the registry office, per year. It should consider the movement of the population with the same citizenship of the area under investigation and obviously of the population with different citizenship. Possible reference area: NUTS 3.

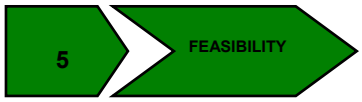
Measurement unit

[inhabitant]

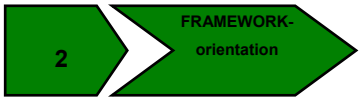
CRITERIA EVALUATION



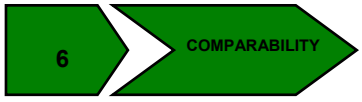
Basic indicator used in social and economic analyses not directly linked to the measurement of traffic impacts.



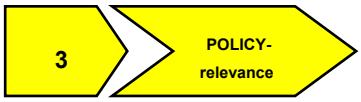
The indicator implementation is easy and precise. Data bases are easily available and the method of collection is uniform the nations interested by the plan.



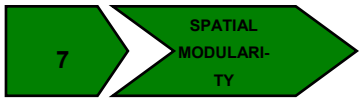
The indicator is used by many international frameworks.



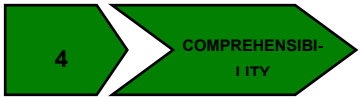
The indicator is easily comparable.



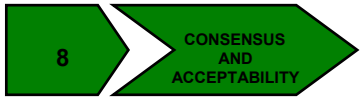
Base indicator that can lead easily to social and economic policies, than can be referred only in an indirect way to mobility policies.



Spatial modularity is good.



The indicator is simple and easily comprehensible.



The indicator is widely used and accepted.

THEMATIC CLASSIFICATION

Group

Group VIII – Cultural potential and social resources (Society)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM

Strengths & Weaknesses

Base indicator useful to the definition of demographic features.

Comments

Progr. N° 810 Unemployment rate

UNDERLYING DEFINITIONS

Definition

The indicator monitors the number of unemployed (in Italy must be considered also the number of young people searching for first occupation) referred to the number of the actives (*) in the considered area. Possible reference: communal area or NUTS 3.

Measurement unit

[n° unemployed/n° actives]

CRITERIA EVALUATION

1 PERTINENCE

Basic indicator used in social and economic analyses not directly linked to the measurement of traffic impacts. It's important to estimate movements (house-workplace and workplace-house).

2 FRAMEWORK-orientation

The indicator is used by many international frameworks.

3 POLICY-relevance

Base indicator that can lead easily to social and economic policies, than can be referred to mobility policies. (right management of commuters, route-management, etc.)

4 COMPREHENSIBI-LITY

The indicator is simple and easily comprehensible.

5 FEASIBILITY

The indicator implementation is easy and precise. Data bases are easily available and the method of collection is uniform the nations interested by the plan.

6 COMPARABILITY

The indicator is easily comparable.

7 SPATIAL MODULARI-TY

Spatial modularity is good.

8 CONSENSUS AND ACCEPTABILITY

The indicator is widely used and accepted.

THEMATIC CLASSIFICATION

Group

Group VIII – Cultural potential and social resources (Society)

DPSIR

D*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Proposta IRE/CETEM

Strengths & Weaknesses

Important socio-economic indicator.

Comments

(*) Employed/active: “person occupied in an legal-economic unit (in extensive sense: plant, laboratory, office, agency, warehouse, professional study, school, hospital, customs-house, house, etc.) as independent or dependent worker (full time, part-time or with a formation contract), even if temporary absent from the job (holiday, disease, unemployment compensation, etc.)” (from www.istat.it). The difference is referred to the logical level to which it’s reported the survey: the employed is reported to the residence, the active to the town in which the legal-economy unit is situated.

Progr. N° 901 **Bed places in open and closed hotels and resorts per inhabitant**

UNDERLYING DEFINITIONs

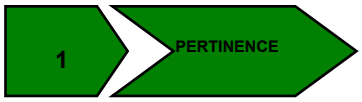
Definition

The indicator measures the number of beds in hotels and resorts (*) per inhabitant (NUTS 3 area). Tourism is a very important activity, because it contributes to the permanence of the local population and it supplies a fundamental contribution to the economy of the alpine territory.

Unit of Measurement

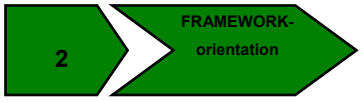
[n° bed places/inhabitant]

CRITERIA EVALUATION

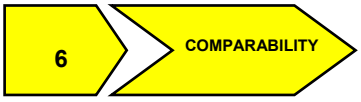


The indicator is one the most important signals for the tourism sector.

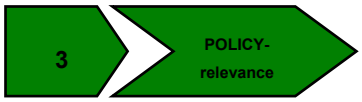
The indicator does not need particular calculations but the availability of data can be critical.



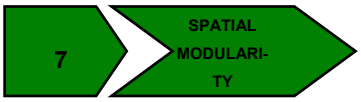
The indicator is considered by many framework about sustainable development.



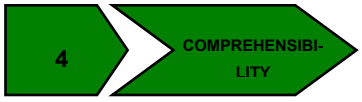
The indicator comparability is limited by the possibility of a good data collection.



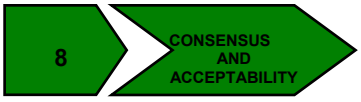
The indicator allows, if historical series are analyzed, to control the tourist activity and its economic and cultural valences.



The indicator has a good spatial modularity.



The indicator is very simple and easily comprehensible.



The indicator is widely used by international institutes to analyze the tourism potential.

THEMATIC CLASSIFICATION

Group

Group IX – Tourism capacities (Tourism)

DPSIR

D

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi

Strengths & Weaknesses

The indicator is commonly used to estimate the intensity of the tourism activity and to identify also touristic poles.
Unfortunately inside different States the definition and the data mining aren't harmonized and moreover the indicator can not usually supply all the information that would be useful to a deep analysis.

Comments

Indicator variations:

Bed places in open and closed hotels and resorts.

Trends in bed places in open and closed hotels and resorts per inhabitant.

Trends in bed places in open and closed hotels and resorts per inhabitant in terms of increase or bending percentage.

(*) hotels: structures like hotels, pensions, etc.
resorts: apartments, youth hostels, alpine shelters, camps (Bätzing, 1997, in Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi, 2004)

Progr. N°. 903 Ovenight stays per inhabitant

UNDERLYING DEFINITIONS

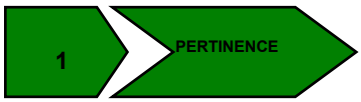
Definition

The indicator monitors the number of overnight stays combined for summer and winter season in hotels and resorts(*) per inhabitant (it's considered a local area). Such indicator represents an approximate esteem for "tourism intensity".

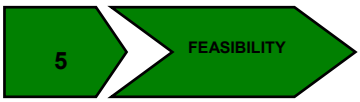
Unit of Measurement

[n° stays/inhabitant]

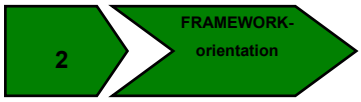
CRITERIA EVALUATION



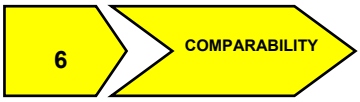
The indicator is important to calculate pressures induced by tourism activities.



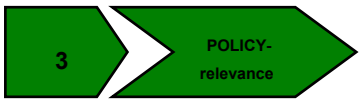
The indicator is widely used and the implementation is simple.



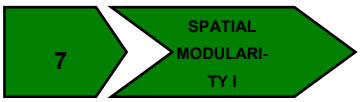
The indicator is considered by many indicators lists about sustainable development.



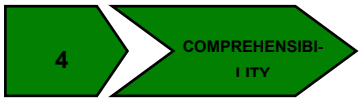
Comparability appears not guaranteed because of data collection is not easy.



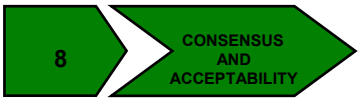
The indicator is useful to implement policies about tourism stays and traffic.



Spatial modularity is good.



The indicator is easily comprehensible and it uses a simple measurement unit.



The indicator is usually used by European institutes to value tourism impacts.

THEMATIC CLASSIFICATION

Group

Group IX – Tourism capacities (Tourism)

DPSIR

D

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi

Strengths & Weaknesses

The indicator is commonly used and easily interpretable. The existence of different definitions and surveys can render the result of the calculation not comparable.

Comments

Indicator variations:

Trends in ovenight stays per inhabitant combined for summer and winter season in terms of increase or bending percentage.

Ovenight stays per bed place.

Average length of time of the stay.

(*) hotels: structures like hotels, pensions, etc.
resorts: apartments, youth hostels, alpine shelters, camps (Bätzing, 1997, in Documentare le trasformazioni dell'habitat alpino, Convenzione delle Alpi, 2004)

Progr. N° 002 Transport accidents, fatalities and injuries

UNDERLYING DEFINITIONS

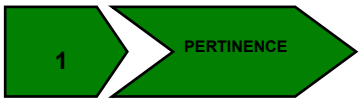
Definition

The indicator measures the number of road accidents, fatalities and injuries per year. This indicator represents a fundamental signal to monitor the impacts of transport on human health.

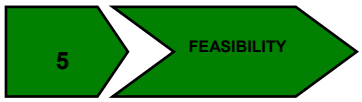
Unit of Measurement

[n°of transport accidents, fatalities and injures]

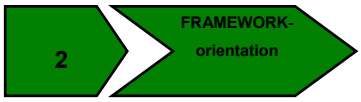
CRITERIA EVALUATION



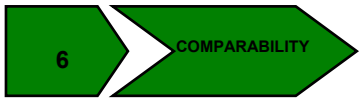
The indicator is an important signal of dangerousness for the population.



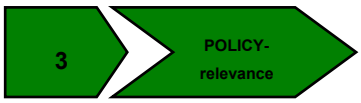
The indicator is easily implementable and it does not need a particular elaboration.



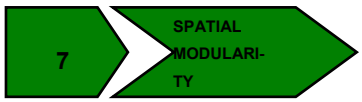
The indicator is considered by a lot of international frameworks.



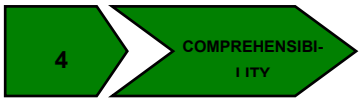
The indicator is comparable if it's well-calculated.



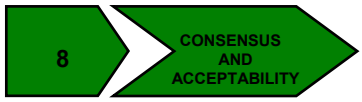
The indicator is fundamental to verify emergency-policies.



The indicator has a good spatial modularity.



The indicator is easily comprehensible.



The indicator is widely used from many years in different analysis.

THEMATIC CLASSIFICATION

Group

Group X – General conditions of quality of life (Quality of life)

DPSIR

I*

Relevance

Core

RESEARCH & DEVELOPMENT

Indicator Source

Processo TERM dell'Agenzia Europea per l'Ambiente (EEA)

Strengths & Weaknesses

The indicator can monitor the direct effects of road traffic on human health. It is necessary however to consider that transport has also indirect impacts on human health.

Comments

The right territorial scale can be obtained during calculation according to the effective availability of data; generally it can be used a NUTS 2 area.

Progr. N° 008 Noise exposure (LDEN)

UNDERLYING DEFINITIONS

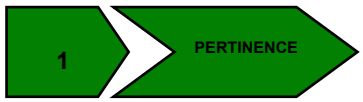
Definition

The indicator measures the noise exposure defined in terms of the “average” levels during daytime, evening, and night-time. It applies a 5 dB penalty to noise in the evening and a 10 dB penalty to noise in the night (*).

Unit of Measurement

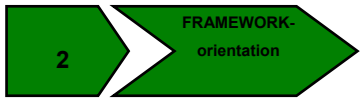
[SEL (Sound Exposure Level)]

CRITERIA EVALUATION

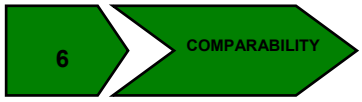


The indicator measures population exposure to noise

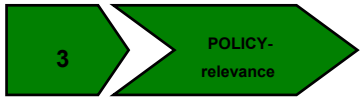
Available for high populated areas but not precisely everywhere.



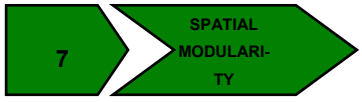
European standard define by directive 2002/49/CE.



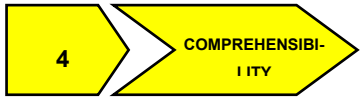
European standard define by directive 2002/49/CE.



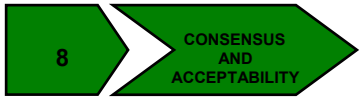
Direct link with quality of life.



Data are given by region.



Can be used only for comparison between 2 areas.



European standard define by directive 2002/49/CE. Has been extended to airport noise.

THEMATIC CLASSIFICATION

Group

Group X – General conditions of quality of life (Quality of life)

DPSIR

P

Relevance

Key

RESEARCH & DEVELOPMENT

Indicator Source

Proposta WP 5/EU directive 2002/49/CE

Strengths & Weaknesses

This indicator is a standard and the same in all EU. The data collected in the different areas are easily comparable because they are based on the same calculation. But it is not an optimal indicator to measure short noise such as a passage of a train. The effect is also not the same in cities and calm areas in open country.

Comments

The definition is as follows:

$$L_{den} = 101\ g\ \frac{1}{24}\left(12 \times 10^{\frac{L_{day}}{10}} + 4 \times 10^{\frac{L_{evening}+5}{10}} + 8 \times 10^{\frac{L_{night}+10}{10}}\right)$$

Here Lday, Levening, and Lnight are the A-weighted long term LAeq as defined in ISO 1996-2 (1987) for the day (7-19h), evening (19-23h), and night (23-7h) determined over the year at the most exposed facade.