# TYPES OF STANDARDS

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## Summary

This contribution introduces the concept of environmental standards. They are aimed at avoiding adverse health effects which might result from exposure to high pollution levels, protecting environmental quality or supporting sustainable development.

Environmental standards are defined in the context of their establishment: they are based upon guideline values and are related to alarm and guide level values.

Although modern environmental standards originated from the idea that they could avoid the repetition of the dramatical impact of the London smog episode in 1952 on human health, decision makers currently use them to realize a wide panache of environmental policy targets including; source targeted action, the prevention of unnecessary pollution, life cycle management, quality improvement focusing on environmental characteristics, standstill principle, BAT and BATNEEC implementation and the precautionary principle. These different elements can be traced back to different degrees in the sets of standards which are handled today.

Environmental standards can be categorized in different ways. An interesting way of tiering them is linked to the environmental effects chain. This procedure results in a functional subdivision of behavioral, product, process, emission, zoning, immission, environmental quality and exposure standards.

Standards are partly attractive because they are easy to use. However this simplicity is only apparent. Because of their complex and varied background they are difficult to interpret. Moreover they tend to oversimplify the environmental reality.

In spite of these limitations, standards are one of the oldest instruments for environmental management and are still described as a necessary element in the environmental instruments policy mix.

## 1. Scope of standards

Environmental problems are manifold and complex. Air pollution might be linked to high tropospheric ozone concentrations, precipitation of acidifying substances, or greenhouse gases which contribute to climatic changes. Water pollution should not reach concentrations which are so high that drinking or bathing water might endanger human health, and surface water should allow for a number of environmental functions such as providing a comfortable breeding environment for fish. Soil pollution might be very extensive and industrialized countries are especially discovering today that they have to clean up hundreds of thousands of contaminated sites. Food should not contain pollutants in amounts which impair health.

In all of these cases one might attempt to set values indicating levels which should not be exceeded to guarantee health, environmental quality or other policy targets: this value can be a standard.

## 2. Definitions

Standards are policy instruments. They belong to the group of physical instruments for environmental policy. This group includes e.g. state of the environment studies, environmental planning, environmental impact studies, life cycle analysis and a set of environmental accounting techniques. Physical policy instruments are as a group complementary to e.g. economic, education and communication instruments. Among them standards belong to the oldest instruments of environmental policy. They are often described as necessary and unavoidable elements of an environmental instruments policy mix.

For environmental standards the environmental component can have at least two different meanings:

(a) to the extent that standards aim at avoiding negative health consequences of exposure to pollutants, the standard should apply in near-ground level outdoor locations where a person might reasonably be expected to be exposed over the relevant average period (DOE, 1997).

(b) however the conviction is growing that environmental standards should not only protect human health, but should rather protect the environment.

Next to this, standards can be used to support sustainable development, which is a more recent target for environmental policy. Avoiding adverse health impacts from high pollution levels, protecting the environment and contributing to sustainable development are the main targets of environmental standards.

The basis on which a standard is set can vary according to the type of standard, but to the extent that standards are aimed at protecting human health or the environment, standards are based upon "*guidelines*". The guideline value is the maximum permissible concentration that guarantees an acceptable health condition or environmental quality. The estimation of the guideline value is based on a professional review of all avoidable and relevant toxicological and epidemiological information, including data on the fate and behavior of substances in the environment and the human body. In addition to toxicological and epidemiological data, guidelines also include a "safety factor" which reflects scientific uncertainty on the available data. This uncertainty merely has to do with different aspects of extrapolation of data e.g. from laboratory animals to humans, or from high dosage rates to low dosage rates, or from healthy individuals to the population as a whole. Safety factors can differ substantially from pollutant to pollutant (from 1 to 10 000). Because a guideline entails a safety factor, and because of the variation of the value of this safety factor, it is not possible to immediately conclude the health or environmental quality risk when the guideline is exceeded.

In general, guidelines are established by (international) panels of experts acting for and on behalf of relevant international organizations. The World Health Organization (WHO) has developed a comprehensive set of guidelines for drinking water and a more limited set of values for air pollutants. The International Agency for Research on Cancer (IARC) determines if a substance causes cancer. Other sources of air quality standards are the European Commission, the US Environmental Protection Agency (US EPA) and other national bodies such as the UK Expert panel on Air Quality Standards (EPA QS).

A "*standard*" is a value "fixed by authorities". In general, it is enshrined in a legal regulation and therefore has "legal force". Although a standard is based upon a guideline, it also takes into account technical, economic, social, cultural or political aspects. "Feasibility" is the most important criterion in this respect. Economic aspects will invariably look at the cost of standard application. In certain circumstances reasons are accepted to pursue policies which result in pollutant concentrations above or below the guideline values.

An example of a technically influenced standard is the European standard for pesticides in drinking water. The philosophy behind this standard is that citizens from EU countries have the right to drink pesticide-free water. This "zero-exposure-level" has been defined as the smallest quantity of pesticides which could be measured in the 1970s when the European Directive on drinking water quality was formulated. Although chemical detection methods became more sensitive later on and much lower concentrations are currently measured than in the 1970s, the levels did not decrease because pesticides in the environment and in drinking water in particular have increased in many areas of the Union. Lower standards were consequently not launched, mainly because of feasibility reasons.

Europe's standards on the concentration of nitrates ($NO_3$) in drinking water provides an example of a standard influenced by economic and political considerations. The "natural" concentration of nitrate in water is less than 1 mg $l^{-1}$. Pollution stems mainly from manure and inorganic fertilizers used in agriculture. The WHO has established a guideline of 45 mg $NO_3$ per liter of water ($NO_3$ mg $l^{-1}$). But, despite substantial evidence to implement an even lower concentration (Speyers et al., 1987), the European Directive of 17 July 1982 specifies a higher value of 50 $NO_3$ mg $l^{-1}$. The main justification for this higher value is economic. Nitrate pollution in several regions (e.g. which have an intense pig breeding and raising industry) of the Union is dramatically high, and much of the drinking water in those regions has $NO_3$ concentrations of 50 $NO_3$ mg $l^{-1}$ or higher. Reduction of nitrate concentration is not considered an economically feasible proposal, hence the EC value of 50 $NO_3$ mg $^{-1}$. On the other hand the Union knows that this value is too high and recommends bringing the level down to 25 $NO_3$ mg $l^{-1}$. The 50 $NO_3$ mg $l^{-1}$ level is therefore fixed as the "maximum admissible concentration" (MAC) and the 25 $NO_3$ mg $l^{-1}$ value as a "*guide level*" (GL) or "*objective level*" limit. This guide or objective level is the political target to be reached in order to avoid damage to health or to the environment.

For a number of pollutants, however, the use of guidelines and standards aimed at avoiding negative impacts on human health and the environment has become unrealistic. For example, tropospheric ozone concentrations in many countries often exceed the WHO guideline of 200 micrograms of ozone per cubic meter of air ($\mu g\ m^{-3}$) for 1 hour, or 65 $\mu g\ m^{-3}$ for 24 hours. There is no safety factor built into these guidelines because they are based upon data (i.e. respiratory capacity in children) obtained from human populations. As a result, ozone concentrations during sunny days regularly impact human health. For this reason standard regulators advocate the establishment of what are called "*alarm levels*". For "Los Angeles type" smog (i.e. those with high ozone concentrations) the recommended alarm level values should be based on:

(a) specification of what effects on human health and the environment the authorities definitely wish to avoid, and
(b) specification of pollutant concentrations causing these effects.

These alarm levels will, as a rule, be higher than guideline or guide level values. The establishment of alarm levels takes into account an evaluation of the seriousness of damage to health or environment. It is hardly necessary to mention that such a choice is ethically loaded and, therefore, much more difficult to make objectively than a "no effect" level. Moreover, at present, there is experience of establishing guidelines and standards, but almost none in defining alarm levels. Figure 1 recalls the different control level values and their key characteristics.

Guidelines, guide values and alarm levels determine to a significant extent the context of environmental standards. This context is more important than a definition. There is no unique definition for environmental standards, but rather a broad set of definitions. A definition which puts emphasis on the function of standards is: the concentration of a substance that should not be exceeded in an environment if harm (to humans and/or ecosystems) is to be avoided (Calow, 1999). A standard can equally be defined as an exact value, physical entity or abstract definition established by an authority and/or custom and practice as a reference, yardstick, model or rule in measurement procedures, in establishing practices or procedures, or in evaluating auditing activity.

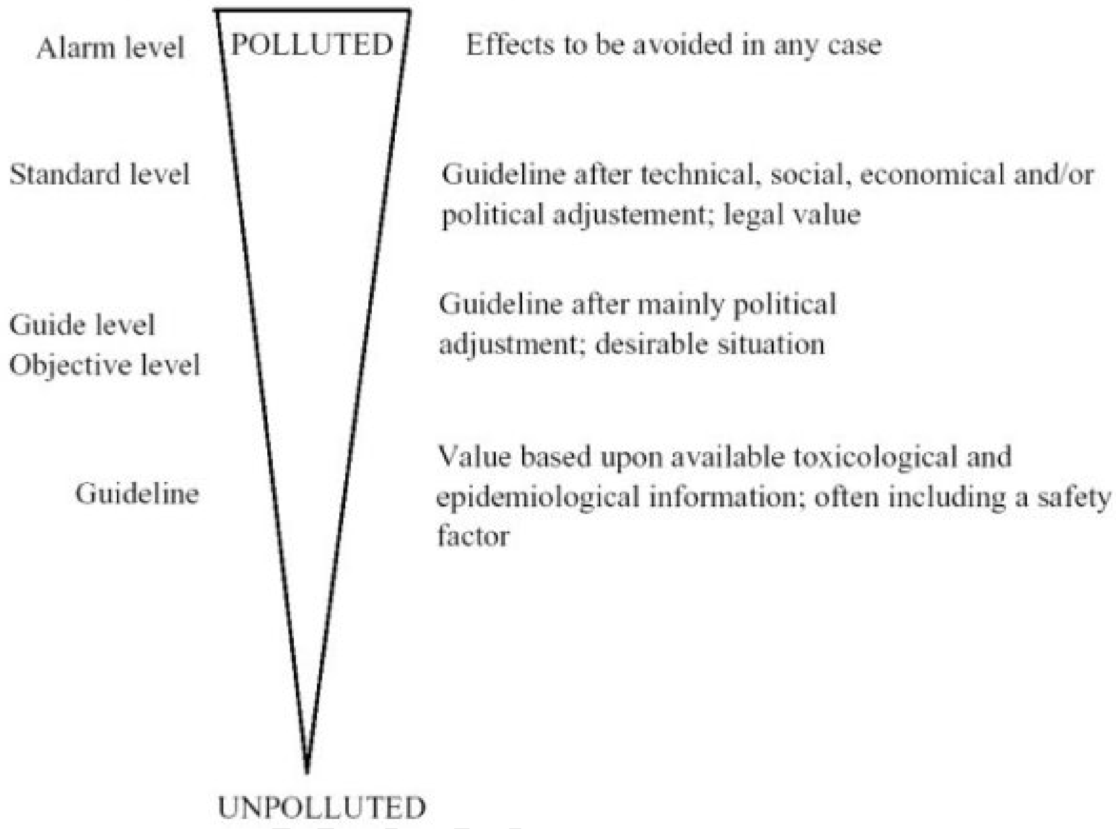


Figure1. Control level values in ascending order; the right side shows the key characteristics of the corresponding value shown at the left.

This definition combines characteristics with legal aspects and functions. One of the wider, policy oriented definitions indicates that "standards are rules by which authorities indicate which environmental target needs to be reached" (Ragas et al., 1994). Another policy targeted and widespread definition of standards is that standards are rules, essentially expressed in quantitative terms, with a defined degree of legal value. A more limited definition which links the use of standards to the protection of human health says "a standard is a concentration of a pollutant below which effects on human health are expected to be zero or negligibly small at a population level" (Harrison, 1998). A definition which puts emphasis on the legal and maintenance aspect of a standard is "a requirement in legislation that if breached or contravened is likely to invite prosecution" (Calow, 1999).

Whatever the target might be, standards might specify these targets with different precision and varying degrees of detail. Indicating that standards should bring back salmon in the Thames or increase the gorilla population in Tanzania are general, qualitative targets. Indicating that the concentration of cadmium in fresh water should not be higher than 0.2 $\mu g\ l^{-1}$ provides a detailed standard.

In general, standards are associated with the level of detail indicated in the last example. They indicate maximum allowable concentrations of a chemical, biological or physical pollutant in one of the environmental compartments (air, water, soil) or food.
In most countries standards are legally fixed. This enhances their effectiveness as an instrument to protect health and the environment. But at the same time they guarantee legal security to the different target groups of environmental policy including industry, farmers and the transport sector. No one can claim environmental negligence afterwards when the different sectors comply with the legally embedded standards.

Not all standards are legally binding. Standards targeted at improving the quality of products or processes (such as ISO-standards for environmental care systems of which environmental auditing is an important part, and life cycle analysis) are part of schemes to which companies voluntary agree. As there is no legal stimulus, an important driving actor is the certification which is linked to some of these schemes, next to the growing concern on internal environmental policies for companies.

As a reference framework, environmental standards affect any target group involved in environmental policy. They originate from the scientific community; they are only made effective after a political decision; this decision takes into account advice of all target groups affected; they need to be implemented by the polluters; they need to be controlled by the civil servants. From this point of view standards are a complete policy instrument.

If standards are targeted towards individuals or individual organizations, they are as a rule part of permits.

Standards, as an instrument for environmental policy, usually do not stand alone. They are accompanied by supporting measures. These might include (legal) indications on how to reach the standard; guidelines on actions when environmental standards are not reached or exceeded; penalties when standards are not met; etc. Legislation on standards can entail e.g. measures to forbid vegetable consumption originating from gardens where soils contain more than 5 mg of cadmium per kg of dry matter, or of cow milk containing 6 or more picograms TEQ of dioxins per gram fat.

The key characteristics of standards used in environmental policy are as follows. They must:

1. Set a general rule for one specific aspect;
2. Address health, environment, materials or pollution sources;
3. Set purely quantitative values for pollutants, which should not be exceeded;
4. Be targeted towards ecosystems or populations rather than to individuals;
5. Preferably, they should have legal force.

The above concerns standards which set general rules for one specific quality aspect of water, air, soil or the ecosystem. This rule is generally quantitatively described as a concentration and an averaging time, although some standards are described only in a narrative, qualitative way. For reasons of effectiveness, a standard value should preferably have legal force.

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**Biographical Sketch**

**Professor Luc Hens** obtained his Licentiate in Biology from the Free University of Brussels (VUB) in 1974, Aggregation of Higher Secondary School Teaching from the VUB in 1975, and PhD from the Faculty of Science of the VUB in 1981.

Professor Hens is a member of several professional societies and recipient of a number of honours and awards, including the prestigious award of the Belgian Royal Academy of Sciences and Arts which he was awarded in 1984. Currently he is the Head of the Department of Human Ecology at the VUB.

He has been responsible for organising and/or participating in several international research and postgraduate teaching programmes in many countries including Bolivia, Bulgaria, Brazil, Brussels, the Czech Republic, Ghana, Hungary, Turkey, the Ukraine and Vietnam.

To date the publications of Professor Hens number about 200 including twenty-six books. He is also the co-editor of the journals *Environment, Development and Sustainability* and *Environmental Pollution.* His teaching and research interests include environmental management, sustainable development, human ecology, and related issues.