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Re: Draft article on air pollution.

Greater awareness of air pollution and its effects

The issue of air pollution and how it affects the health of exposed individuals, is increasingly becoming the focal concern of both the general public and decision-makers. Far from being a passing fad, the phenomenon highlights a combination of several factors:

- While higher standards and technological advances in the fields of industry as well as transport are bringing down the unit emissions, expected improvements in air quality are counteracted by growth, in particular of road traffic.

- Scientific progress has led to pollution being perceived as a full-fledged public health issue, and no longer as the cause of mere discomfort.
- As society continues to evolve, quality of life and health are quite naturally becoming greater priorities. While pollution has sometimes been associated with economic growth and a general improvement in living standards, society now wants growth to occur without pollution being the inevitable corollary.

It was against this backdrop that the law proclaimed on 30 December 1996 governing air and the rational use of energy, affirmed society's right to information on air quality and the effects of pollution on health, as well as the right to breathe air that was not detrimental to our health.

At the same time, recent research has highlighted the significant effects of background pollution, which has long-term effects (heart and lung disorders, cancers). From an economic viewpoint, they have led to a revision of the monetary damage, market or non-market, caused by these pollutants. Compared with assessments carried out in the mid-90s, this upward revision could result in a two-fold increase of these figures.

In spite of scientific advances, pollution-forming mechanisms and the ensuing consequences are so complex that current levels of knowledge are still insufficient. A greater understanding of these phenomena is indispensable, and multidisciplinary research work needs to be conducted in a variety of fields, including physics and chemistry, epidemiology and economics. Much now depends on this knowledge being acquired.

1. The challenge of understanding pollution and its effects has now become particularly important

The primary challenge entails fulfilling **our duty of informing the public** on pollution levels and their effects on health or health hazards.

Firstly, our aim is to provide objective information on pollution and its causes, enabling the public to make as accurate an assessment as possible of its consequences. Indeed, everyone should be aware of pollution levels in his or her environment. However, this public awareness campaign should not be a vehicle for misleading ideas, e.g. of ever increasing pollution levels.

Secondly, the public needs to be informed of effects on health or health hazards. However, this information should also contribute to a greater sense of responsibility among the polluters themselves

(companies or individuals) and make them receptive to measures designed to improve the situation (see below). The most effective measures are not necessarily the most popular, as everyone is both polluter and victim.

The next challenge involves targeting this information and sense of awareness at the decision-makers, so that air pollution may be factored into the **definition of public policies**. This not only includes direct measures to protect society from pollution, but also sectoral or transverse policies.

Awareness of the harmful nature of each pollutant is obviously a prerequisite for providing direct protection against its effects. One of the first things that comes to mind is the definition of pollution peaks and the accompanying regulatory measures, e.g. alternating traffic, or the various standards designed to limit the emissions, such as those governing the fuel-engine combination. Today it is of prime importance to understand that fine particles are one of the major pollutants that cause cardiopulmonary diseases and cancers. It is also essential to know that over and above the more flagrant aspects associated with peak pollution levels, air pollution causes damage at relatively low concentration levels if people are exposed to it for long periods of time. The problem of background pollution seems essential in this context, even if it is currently less targeted by the media than pollution peaks.

In addition to the availability of qualitative information on the harmfulness of the various gases, we need to be able to quantify and evaluate the damage caused before defining the measures to be implemented. An under-estimation of this damage would result in the implementation of flimsy measures that fail to address the severity of the problem. However, an overestimation could lead to various human activities being abusively penalized, even though they are potential sources of well-being.

The example of fiscal policy is particularly enlightening. The taxation of polluting activities and products provides economists with an especially effective tool when it comes to dealing with the externalities of pollution. The quantitative knowledge and evaluation of damage, market or non-market, should make it possible to determine the level of taxation on various fuels, for instance, in order to internalize effects which are not taken into account by market prices.

This example illustrates the amount of knowledge required in order to come up with a truly satisfactory economic policy. We need to be able to isolate the effects of the various activities, and within the transport sector, to identify the specific effects of the various fuels. This ability relies on a sound knowledge of the various emission sources and their dispersion, in order to have an exact understanding of the link between emissions and public exposure to pollution. Finally, the effects on health brought about by the various pollutants must be fully understood.

It is also very important to be able to differentiate between an emission's effect in urban areas, where pollution is a particularly serious problem, and the effects produced by emissions in the countryside. However, we are forced to recognize the obstacles placed in our way by the lack of convenient pricing tools. While fuel taxation is not the proper instrument for differentiating between urban and rural contexts, a toll on fuel consumption in urban areas (or failing this, on driving time or mileage) is not available as yet, even if some countries have experimented with certain forms of urban toll system. While it is true that such systems encounter problems of acceptance by the public, one of the

challenges in informing the public about pollution also involves promoting society's acceptance of measures designed to curtail it (see above).

Attempts to readjust the balance in the transportation of goods by rail and road, and between collective and individual means of urban transport (or at least attempts to curtail a growing imbalance) provide examples of sectoral policies driven largely by environmental considerations, and in particular by the fight against pollution.

The development of renewable energy forms (wind power, for instance) would also be a major challenge in terms of pollution, if the market share of nuclear power were to diminish in the future, to the advantage of conventional power generation.

At a more micro-economic level, pollution awareness is essential when it comes to **choosing projects**. While being an inevitably simplistic device, economic calculation could provide a significant vector for factoring environmental issues into public decision-making, by attributing a monetary value to the effects of pollution. However, this value must naturally be based on the soundest possible knowledge of pollution issues.

This method is not only designed for the quantitative incorporation of pollution's effects into public choices, or more precisely, into decision-making aids. It is also an effective means of rationalizing the way in which the information is incorporated. Assessing projects and their environmental aspects by means of purely qualitative methods based on multiple criteria, could implicitly result in very different appraisals of the same damage. As a consequence, the community could agree to spend a certain amount in order to avoid particular types of pollution, but could refuse to spend a lesser amount in order to avoid other types of pollution that produce more significant effects.

On the whole, awareness of air pollution and its effects has major implications. Our current, sufficient level of awareness no longer enables us to hide behind uncertainties and consequently ignore the effects produced by pollution. Nevertheless, the issue would doubtless be better addressed by acquiring more knowledge on the subject. The reasons for this are technical on the one hand, while on the other, the drive for social acceptance would have to be seen as being based on reliable information.

2. Continued research remains essential for greater levels of awareness.

In order to acquire more knowledge on the subject of air pollution and its effects on the public multidisciplinary research needs to be conducted in very diverse areas, mainly concerning emissions, dispersion, the harmful nature of pollutants and the monetary value of the damage incurred.

With regard to emissions, particular progress has been made concerning the link between fuel composition and vehicle emissions. A potential reduction in the number of emissions probably depends on more detailed research work.

Knowledge and modeling of how the various pollutants spread are essential for several reasons: definition and integration of technical features into fixed installations (height of plant stacks, for example), knowledge of the harmful nature of various means of transport (spreading of pollutants

determines the relative impact of urban, rural or mountain traffic), installation of measuring stations. Significant progress has already been made in this regard, and it seems to be accepted that the range of primary or secondary pollutants is wider than was thought to be the case a few years ago.

Knowledge of the effects on health produced by exposure to various pollutants is naturally a decisive factor. Research work of the dose-response type conducted by Pope in the United States now seems to indicate that the major effects produced by pollution concern "long-term" morbidity (chronic bronchitis) and mortality (cardiovascular hazards, cancers), i.e. increased prevalence due to long periods of exposure to pollution, even at relatively low concentration levels. This essential point probably needs to be validated and adapted to a French or European framework by further in-depth dose-response studies.

Finally, with regard to the economic aspect, the "valuation" of damage incurred raises the issue of non-market goods. The assignment of a monetary value to non-market effects felt by the "victims" of pollution and their environment (such as diminished quality of life) is achieved by applying various methodologies.

- Contingent valuation based on the willingness to pay, i.e. the amount that individuals subjected to external effects are willing to pay to stop these effects. The technique employed is that of the one-to-one interview, and possibly the creation of scenarios designed to reveal the individual's willingness to pay. Two approaches are conceivable:
 - . Asking direct questions about the willingness to pay for a certain reduction in air pollution. All members of the public are concerned.
 - . Interviewing individuals suffering from certain disorders associated with pollution (chronic bronchitis, for instance) in order to establish their willingness to pay to end their suffering. Although this approach is preferable in theory, the variety of practices may also justify use of the first method.
- Hedonic method. This measures, for instance, the drop in the price of homes exposed to various levels of pollution. This method generally employs econometric techniques designed to isolate the effect of the observed pollution type from the various other factors that determine the price.

In cases where it is feasible, this method, which measures the value actually attributed to a given type of pollution according to its importance, is intrinsically preferable to that of contingent valuation. In practice, owing to the difficulties and uncertainties inherent in each method, it would be worth diversifying the methods employed and conducting a comparative analysis of the results obtained.

The assessment of avoidance costs, i.e. the investment required to prevent or reduce polluting emissions, is generally not recommended however, if other damage-related methods are available. Indeed, there is no intrinsic direct link between avoidance costs and those incurred by actual damage (or inconvenience). Granted, in an optimal economic scenario, marginal avoidance costs and marginal incurred costs should be equal. However, there is no reason why the observed situation should reflect the optimal scenario.

Recent studies illustrate the importance of mortality in the valuation of damage associated with pollution. This raises the "value of life" issue, which should be discussed in terms of mortality risk and life expectancy. This issue is mainly dealt with in a road safety context, and the values obtained can

be used as a basis. However, even more than in the case of road safety, a monetary value must be attributed to the years of life lost, the number of which varies greatly in the event of pollution-related death, and is on average lower than the number due to road accidents.

The first type of method, referred to as "human capital", is based on the discounted value of future incomes for each age. This approach, which is strictly oriented towards productivity, and the result of which greatly depends on the chosen discount rate, is open to criticism as it does not factor in non-commercial work or pain and suffering. This delicate issue may justify a determination of the "value of life" based on the willingness to pay, primarily established by applying a contingent valuation method.

While each of the above-mentioned areas requires further research, more synthetic analyses are also essential in order to resolve the issues raised: total socio-economic cost of pollution, differentiation between emissions in urban and non-urban areas, differentiation between emissions produced by diesel or petrol-driven vehicles, analysis of features specific to confined areas such as mountain valleys, etc.

The French Ministry for Land Management and Environment (MATE) is actively involved in setting up strategies and funding for research work on the various topics, in particular via a jointly run research program for better air quality at the local level (PRIMEQUAL). The program is largely funded by the MATE (approx. 6 million FF per annum) and the Environment and Energy Management Agency (ADEME), who share its supervision.

The program comprises five areas of research and the MATE funds the work carried out in all five. Below are some of the research topics it has funded in recent years:

- Socio-political and economic aspects: addressing concerns associated with air quality in urban transport plans; economic and socio-anthropological approach to air pollution.
- Emissions and air quality: MEHARI project (sources other than road traffic); measurement and transformation of volatile organic compounds.
- Dispersion modeling: modeling the transmission of pollutants on an urban scale; statistical forecasting of ozone pollution peaks.
- Measurement of air contaminants and exposure assessment: pesticide volatilization; methods for measuring particle concentration.
- Health hazards: long-term effects of air pollution; effects of diesel particles.