

# GUIDELINES FOR PREPARING ECONOMIC ANALYSES

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# Acronyms and Abbreviations

ABC	Air Benefit and Cost (Group)
AC	annualized costs
ACN	AirControlNET
ADP	Action Development Process
BAT	best available technology
BCA	benefit-cost analysis
BLS	Bureau of Labor Statistics
BMP	Best Management Practice
BPT	best practicable technology
CA	conjoint analysis
CAA	Clean Air Act
CAFO	Combined Animal Feeding Operations
CAAA	Clean Air Act Amendments
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CBO	Congressional Budget Office
CE	certainty equivalent
CEA	cost-effectiveness analysis
CEM	continual emissions monitoring
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFC	chlorofluorocarbons
CFOI	Census of Fatal Occupational Injuries
CFR	Code of Federal Regulations
CGE	computable general equilibrium
CO	carbon monoxide
CO <sub>2</sub>	carbon dioxide
COI	cost of illness
CPI	Consumer Price Index
CR	contingent ranking
CS	compensating surplus
CV	contingent valuation
CV	compensating variation
DALY	disability-adjusted life year
DICE	Dynamic Integrated model of Climate and the Economy
DOE	Department of Energy
DOT	Department of Transportation
DWL	deadweight loss
EA	economic analysis
EBIT	earnings before interest and taxes
EEAC	Environmental Economics Advisory Committee
EIA	economic impact analysis
ELG	Effluent Limitation Guidelines

EO	Executive Order
EPA	Environmental Protection Agency
ES	equivalent surplus
EV	equivalent variation
EVRI	Environmental Valuation Reference Inventory
FINDS	Facility Index Data System
FR	Federal Register
FTE	full-time equivalent employment
GDP	gross domestic product
GHG	greenhouse gases
GIS	Geographic Information System
HCFC	hydrochlorofluorocarbon
Hg	mercury
IAM	integrated assessment model
ICR	Information Collection Request
IEc	Industrial Economics, Inc.
IMPLAN	Impact Analysis for Planning
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Planning Model
LP	linear programming
MAC	marginal abatement cost curve
MD	marginal external damage curve
MR	marginal revenue
MPC	marginal private costs
MSC	marginal social costs
MSD	marginal social damages
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industrial Classification System
NB	net benefits
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutant
NFV	net future value
NH <sub>3</sub>	ammonia
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NO <sub>x</sub>	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NWPCAM	National Water Pollution Control Assessment Model
OAQPS	Office of Air Quality Planning and Standards
OCC	opportunity cost of capital
OECD	Organization for Economic Cooperation and Development
OGC	Office of General Counsel
OIRA	Office of Information & Regulatory Affairs
OLS	ordinary least squares

## **Acronyms and Abbreviations**

OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
OTEA	Office of Trade and Economic Analysis
PACE	Pollution Abatement Costs and Expenditures
PAOC	pollution abatement operating cost
PM <sub>2.5</sub>	particulate matter, 2.5 microns in diameter or less
PM <sub>10</sub>	particulate matter, 10 microns in diameter or less
POTW	publicly-owned (wastewater) treatment work
PRA	Paperwork Reduction Act
PVC	present value of costs
QA	quality assurance
QALY	quality-adjusted life year
R&D	research and development
RAPIDS	Rule and Policy Information Development System
RACT	Reasonably Available Control Technology
RCRA	Resource Conservation and Recovery Act
RDD	random digit dialing
REMI	Regional Economic Models, Inc.
RFA	Regulatory Flexibility Act
RIA	regulatory impact analysis
RUM	random utility maximization
S&P	Standard & Poor's
SAB	Science Advisory Board
SAM	social accounting matrix
SBA	Small Business Administration
SBREFA	Small Business Regulatory Enforcement Fairness Act
SCC	social cost of carbon
SIC	Standard Industrial Classification
SISNOSE	significant economic impact on a substantial number of small entities
SO <sub>2</sub>	sulfur dioxide
SWC	Survey on Working Conditions
TAMM	Timber Assessment Market Model
TMDL	Total Maximum Daily Loadings
TRI	Toxics Release Inventory
TSLS	two-stage least squares
UMRA	Unfunded Mandates Reform Act
UPF	utility possibility frontier
USC	United States Code
VOC	volatile organic compounds
VSL	value of statistical life
VSLY	value of a statistical life-year
WTA	willingness to accept
WTP	willingness to pay

# Glossary

## Annualized value

An annualized value is a constant stream of benefits or costs. The annualized cost is the amount that a party would have to pay at the end of each period  $t$  to add up to the same cost in present value terms as the stream of costs being annualized. Similarly, the annualized benefit is the amount that a party would accrue at the end of each period  $t$  to add up to the same benefit in present value terms as the stream of benefits being annualized.

## Baseline

A baseline describes an initial, status quo scenario that is used for comparison with one or more alternative scenarios. In typical economic analyses the baseline is defined as the best assessment of the world absent the proposed regulation or policy action.

## Benefit-cost analysis (BCA)

A BCA evaluates the favorable effects of policy actions and the associated opportunity costs of those actions. It answers the question of whether the benefits are sufficient for the gainers to potentially compensate the losers, leaving everyone at least as well off as before the policy. The calculation of net benefits helps ascertain the economic efficiency of a regulation.

## Benefits

Benefits are the favorable effects society gains due to a policy or action. Economists define benefits by focusing on changes in individual well-being, referred to as welfare or utility. Willingness to pay (WTP) is the preferred measure of these changes as it theoretically provides a full accounting of individual preferences across trade-offs between income and the favorable effects.

## Benefit-cost ratio

A benefit-cost ratio is the ratio of the net present value (NPV) of benefits associated with a project or proposal, relative to the NPV of the costs of the project or proposal. The ratio indicates the benefits expected for each dollar of costs. Note that this ratio is not an indicator of the magnitude of net benefits. Two projects with the same benefit-cost ratio can have vastly different estimates of benefits and costs.

## Cessation lag

Cessation lag is the time interval between the cessation of exposure and the reduction in risk. See *latency* for a definition of a related but distinct concept.

## Command-and-control regulation

Command-and-control regulation requires polluters to meet specific emission-reduction targets defining acceptable levels of pollution. This type of regulation often requires the installation and use of specific types of equipment to reduce emissions. Command-and-control regulations usually impose the same requirements on all sources, although new and existing sources, taken as groups, are frequently subject to different standards.

## Compliance cost

A compliance cost is the expenditure of time or money needed to conform to government requirements such as legislation or regulation. In the case of environmental regulation, these direct costs are associated with: (1) purchasing, installing, and operating new pollution control equipment; (2) changing a production process by using different inputs or different mixtures of inputs; and (3) capturing waste products and selling or reusing them.

## Consumption rate of interest

Consumption rate of interest is the rate at which individuals are willing to exchange consumption over time. Simplifying assumptions, such as the absence of taxes on investment returns, imply that the consumption rate of interest equals the market interest rate, which also equals the rate of return on private sector investments.

## Cost-effectiveness analysis (CEA)

CEA examines the costs associated with obtaining an additional unit of an environmental outcome. It is designed to identify the least expensive way of achieving a given environmental quality target, or the way of achieving the greatest improvement in some environmental target for a given expenditure of resources.

### Costs

Costs are the dollar values of resources needed to produce a good or service; once allocated, these resources are not available for use elsewhere. *Private costs* are the costs that the buyer of a good or service pays the seller. *Social costs*, also called *externalities*, are the costs that people other than the buyers are forced to pay, often through non-pecuniary means, as a result of a transaction. The bearers of social costs can be either particular individuals or society at large.

### Distributional analysis

Distributional analysis assesses changes in social welfare by examining the effects of a regulation across different subpopulations and entities. Two types of distributional analyses are the economic impact analysis (EIA) and the equity assessment.

### Economic efficiency

Economic efficiency refers to the optimal production and consumption of goods and services. This generally occurs when prices of products and services reflect their marginal costs, or when marginal benefits equal marginal costs.

### Economic impact analysis (EIA)

An EIA examines the distribution of monetized effects of a policy, such as changes in industry profitability or in government revenues, as well as non-monetized effects, such as increases in unemployment rates or numbers of plant closures.

### Elasticity of demand

Elasticity of demand measures the relationship between changes in quantity demanded of a good and changes in its price. It is calculated as the percentage change in quantity demanded that occurs in response to a percentage change in price. As the price of a good rises, consumers will usually demand a lower quantity of that good. The greater the extent to which quantity demanded falls as price rises, the greater is the price elasticity of demand. Some goods for which consumers cannot easily find substitutes, such as gasoline, are considered price inelastic. Note that elasticity can differ between the short term and the long term. For example, if the price of gasoline rises, consumers will eventually find ways to conserve their use of the resource. Some of these ways, like finding a more fuel-efficient car, take time. Hence gasoline

would be price inelastic in the short term and more price elastic in the long term.

### Elasticity of supply

Elasticity of supply measures the relationship between changes in quantity supplied of a good and changes in its price. It is measured as the percentage change in quantity supplied that occurs in response to a percentage change in price. For many goods the quantity supplied can be increased over time by locating alternative sources, investing in an expansion of production capacity, or developing competitive products that can substitute. One might therefore expect that the price elasticity of supply will be greater in the long term than the short term for such a good, that is, that supply can adjust to price changes to a greater degree over a longer period of time.

### Emissions tax

An emissions tax is a charge levied on each unit of pollution emitted.

### Environmental justice

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Meaningful involvement means that: (1) people have an opportunity to participate in decisions about activities that can affect their environment and/or health; (2) the public's contribution can influence the regulatory agency's decision; (3) their concerns will be considered in the decision-making process; and (4) the decision makers seek out and facilitate the involvement of those potentially affected.<sup>1</sup>

<sup>1</sup> Definition taken from <http://www.epa.gov/compliance/environmentaljustice/index.html> (accessed December 22, 2010).

## **Equity assessment**

An equity assessment examines the distribution of benefits and costs associated with a regulation across specific sub-populations. Disadvantaged or vulnerable sub-populations, for example low-income households, may be of particular concern.

## **Expert elicitation**

Expert elicitation is a formal, highly-structured and well-documented process for obtaining the judgments of multiple experts. Typically, an elicitation is conducted to evaluate uncertainty. This uncertainty could be associated with: the value of a parameter to be used in a model; the likelihood and frequency of various future events; or the relative merits of alternative models.

## **Externalities**

An externality is a cost or benefit resulting from an action that is borne or received by parties not directly participating in the action.

## **Flow pollutant**

A flow pollutant is a pollutant for which the environment has some absorptive capacity. It does not accumulate in the environment as long as its emission rate does not exceed the absorptive capacity of the environment. Animal and human wastes are examples of flow pollutants.

## **Hotspot**

A hotspot is a geographic area with a high level of pollution/contamination within a larger geographic area of low or “normal” environmental quality.

## **Kaldor-Hicks criterion**

The Kaldor-Hicks criterion is really a combination of two criteria: the Kaldor criterion and the Hicks criterion. The Kaldor criterion states that an activity will contribute to Pareto optimality if the maximum amount the gainers are prepared to pay is greater than the minimum amount that the losers are prepared to accept. Under the Hicks criterion, an activity will contribute to Pareto optimality if the maximum amount the losers are prepared to offer to the gainers in order to prevent the change is less than the minimum amount the gainers are prepared to accept as a bribe to forgo the change. In other words, the Hicks compensation test is conducted from the

losers’ point of view, while the Kaldor compensation test is conducted from the gainers’ point of view. The Kaldor-Hicks criterion is widely applied in welfare economics and managerial economics. It forms an underlying rationale for BCA.

## **Latency**

Latency is the time interval from the first exposure of a pollutant until the increase in health risk. See *cessation lag* for a definition of a related but distinct concept.

## **Leakages**

A leakage is the displacement of pollution from one location to another as a result of the imposition of tighter pollution controls. Under tradable permit systems, leakages occur when pollution is displaced to an area not affected by a cap on allowed emissions.

## **Marginal benefit**

The marginal benefit is the benefit received from an incremental increase in the consumption of a good or service. It is calculated as the increase in total benefit divided by the increase in consumption.

## **Marginal cost**

The marginal cost is the change in total cost that results from a unit increase in output. It is calculated as the increase in total cost divided by the increase in output.

## **Marginal social benefit**

The marginal social benefit is the marginal benefit received by the consumer of a good (marginal private benefit) plus the marginal benefit received by other members of society (external benefit).

## **Marginal social cost**

The marginal social cost is the marginal cost incurred by the producer of a good (marginal private cost) plus the marginal cost imposed on other members of society (external cost).

## **Market failure**

Market failure is a condition where the allocation of goods and services by a market is not efficient. Causes of market failure include: externalities, concentration of market power, information asymmetry, transactions costs, and the nature of the good (e.g.,

public goods). For environmental conditions, externalities are the most likely causes of the failure of private and public sector institutions to correct pollution damages.

### Market permit systems

A market permit system is a system under which emissions sources are required to have emissions permits matching their actual emissions. Each permit specifies how much the source is allowed to emit and is transferable among firms.

### Market-based incentives

Market-based incentives include a wide variety of methods for environmental protection. Instruments such as taxes, fees, charges, and subsidies generally “price” pollution and leave decisions about the level of emissions to each source. Another example is the market permit system, which sets the total quantity of emissions and then allows trading of permits among firms.

### Meta-analysis

Meta-analysis is a statistical method of pooling data and/or results from a set of comparable studies of a problem. Pooling in this way provides a larger sample size for evaluation and allows for a stronger conclusion than can be provided by any single study. Meta-analysis yields a quantitative summary of the combined results.

### Net benefits

Net benefits are calculated by subtracting total costs from total benefits.

### Net future value

Net future value is similar to NPV, however, instead of discounting all future values back to the present, values are accumulated forward to some future time period — for example, to the end of the last year of a policy’s effects.

### Net present value (NPV)

The NPV is calculated as the present value of a stream of current and future benefits minus the present value of a stream of current and future costs.

### Non-use value

Non-use value is the value that an individual may derive from a good or resource without consuming

it, as opposed to the value obtained from use of the resource. Non-use values can include *bequest value*, where an individual places a value on the availability of a resource to future generations; *existence value*, where an individual values the mere knowledge of the existence of a good or resource; and *paternalistic altruism*, where an individual places a value on others’ enjoyment of the resource.

### Opportunity cost

Opportunity cost is the value of the next best alternative to a particular activity or resource.

Opportunity cost need not be assessed in monetary terms. It can be assessed in terms of anything that is of value to the person or persons doing the assessing. For example a grove of trees used to produce paper may have a next-best-alternative use as habitat for spotted owls. Assessing opportunity costs is fundamental to assessing the true cost of any course of action. In the case where there is no explicit accounting or monetary cost (price) attached to a course of action, ignoring opportunity costs could produce the illusion that the action’s benefits cost nothing at all. The unseen opportunity costs then become the implicit hidden costs of that course of action.

### Quality-adjusted life year (QALY)

QALY is a composite measure used to convert different types of health effects into a common, integrated unit, incorporating both the quality and quantity of life lived in different health states. This metric is commonly used in medical arenas to make decisions about medical interventions.

### Shadow price of capital

The shadow price of capital takes into account the social value of displacing private capital investments. For example, when a public project displaces private sector investments, the correct method for measuring the social costs and benefits requires an adjustment of the estimated costs (and perhaps benefits as well) prior to discounting using the consumption rate of interest. This adjustment factor is referred to as the “shadow price of capital.”

### Social cost

From a regulatory standpoint, social cost represents the total burden a regulation will impose on the economy. It can be defined as the sum of all opportunity

costs incurred as a result of the regulation. These opportunity costs consist of the value lost to society of all the goods and services that will not be produced and consumed if firms comply with the regulation and reallocate resources away from production activities and towards pollution abatement. To be complete, an estimate of social cost should include both the opportunity costs of current consumption that will be foregone as a result of the regulation, and also the losses that may result if the regulation reduces capital investment and thus future consumption.

### Social welfare function

A social welfare function establishes criteria under which efficiency and equity outcomes are transformed into a single metric, making them directly comparable. A potential output of such a function is a ranking of policy outcomes that have different aggregate levels and distributions of net benefits. A social welfare function can provide empirical evidence that a policy alternative yielding higher net benefits, but a less equitable distribution of wealth, ranks better or worse than a less efficient alternative with more egalitarian distributional consequences.

### Stock pollutants

A stock pollutant is a pollutant for which the environment has little or no absorptive capacity, such as non-biodegradable plastic, heavy metals such as mercury, and radioactive waste. A stock pollutant accumulates through time.

### Subsidies

A subsidy is a kind of financial assistance, such as a grant, tax break, or trade barrier, that is implemented in order to encourage certain behavior. For example, the government may directly pay polluters to reduce their pollution emissions.

### Tax-subsidy

A tax-subsidy is any form of subsidy where the recipients receive the benefit through the tax system, usually through the income tax, profit tax, or consumption tax systems. Examples include tax deductions for workers in certain industries, accelerated depreciation for certain industries or types of equipment, or exemption from consumption tax (sales tax or value added tax).

### Total cost

Total cost is defined as the sum of all costs associated with a given activity.

### Use value

Use value is an economic value based on the tangible human use of some environmental or natural resource.

### Value of statistical life (VSL)

VSL is a summary measure for the dollar value of small changes in mortality risk experienced by a large number of people. VSL estimates are derived from aggregated estimates of individual values for small changes in mortality risks. For example, if 10,000 individuals are each willing to pay \$500 for a reduction in risk of 1/10,000, then the value of saving one statistical life equals \$500 times 10,000 — or \$5 million. Note that this does not mean that any single identifiable life is valued at this amount. Rather, the *aggregate value* of reducing a collection of small individual risks is, in this case, worth \$5 million.

### Value of statistical life year (VSLY)

The VSLY is the estimated dollar value for a year of statistical life. In practice this metric is often derived by dividing the VSL by remaining life expectancy. This approach is controversial in that it assumes that each year of life over the life cycle has the same value, and it assumes that the value of a statistical life equals the present discounted value of these annual amounts.

### Willingness to accept (WTA)

WTA is the amount of compensation an individual is willing to take in exchange for giving up some good or service. In the case of an environmental policy, WTA is the least amount of money that an individual would accept to forego an environmental improvement (or endure an environmental decrement).

### Willingness to pay (WTP)

WTP is the largest amount of money that an individual or group would pay to receive the benefits (or avoid the damages) resulting from a policy change, without being made worse off. In the case of an environmental policy, WTP is the maximum amount of money an individual would pay to obtain an improvement (or avoid a decrement) in an environmental effect of concern.

