Treasury Board of Canada Secretariat
Secrétariat du Conseil du Trésor du Canada
Canada

Canada's Cost-Benefit Analysis Guide for Regulatory Proposals

Published: 2022-03-28

Published by Treasury Board of Canada, Secretariat
90 Elgin, Ottawa, Ontario, K1A 0R5, Canada

Catalogue Number: BT58-5/2022E-PDF
ISBN: 978-0-660-43053-9

This document is available on the Government of Canada website, Canada.ca

This document is available in alternative formats upon request.

Aussi offert en français sous le titre : Guide d’analyse coûts-avantages pour le Canada : Propositions de réglementation

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1. Introduction

Cost-benefit analysis (CBA) is a requirement of the Cabinet Directive on Regulation (the Directive), which establishes requirements for federal regulatory proposals. The Directive requires that regulatory proposals and decisions are based on evidence, robust analysis of costs and benefits, and the assessment of risk, while being open to public scrutiny.

The Policy on Cost-Benefit Analysis (the Policy) was launched on September 1, 2018, and sets out the specific requirements for cost-benefit analysis for federal regulatory proposals. CBA monetizes, quantifies and qualitatively analyzes the direct and indirect costs and benefits of the regulatory proposal to determine the proposal's overall benefit. CBA is not limited to justifying a course of action, it plays an important role in determining which course of action to take.

This guide has been developed by the Centre of Regulatory Expertise in the Regulatory Affairs Sector of the Treasury Board of Canada Secretariat (TBS) to assist departments and agencies in complying with the analytical and transparency requirements of the Policy, in order to produce high quality cost-benefit analysis across the federal government.

For additional information or questions, please contact the Centre of Regulatory Expertise at TBS.

2. Cost-Benefit Analysis: Analytical Requirements

Before undertaking CBA, it is essential that CBA analysts have an in-depth understanding of the objectives of the regulatory proposal, including the proposal's underlying risks, as well as other regulatory options under consideration. Early engagement with policy/program analysts responsible for developing the regulation is essential. This will allow CBA analysts to:

- better define the baseline;
- identify needed data and impacted stakeholders;
- facilitate early identification of approaches/methodologies to estimate the costs and benefits; and,
- contribute to regulatory design.

In carrying out CBA, departments and agencies are encouraged to follow the five analytical steps below, which are intended to facilitate a disciplined approach to assessing the costs and benefits of a regulatory proposal and its feasible alternative regulatory options.

Figure 1. Analytical steps in Cost-Benefit Analysis

> **Step 1:** Establishing the baseline and regulatory scenario(s)
> **Step 2:** Identifying, estimating and monetizing the benefits and costs

Step 3: Comparing benefits and costs

Step 4: Assessing uncertainty / Sensitivity analysis

Step 5: Conducting distributional analysis

3. Step 1: Establishing the baseline and regulatory scenario(s)

▶ In this section

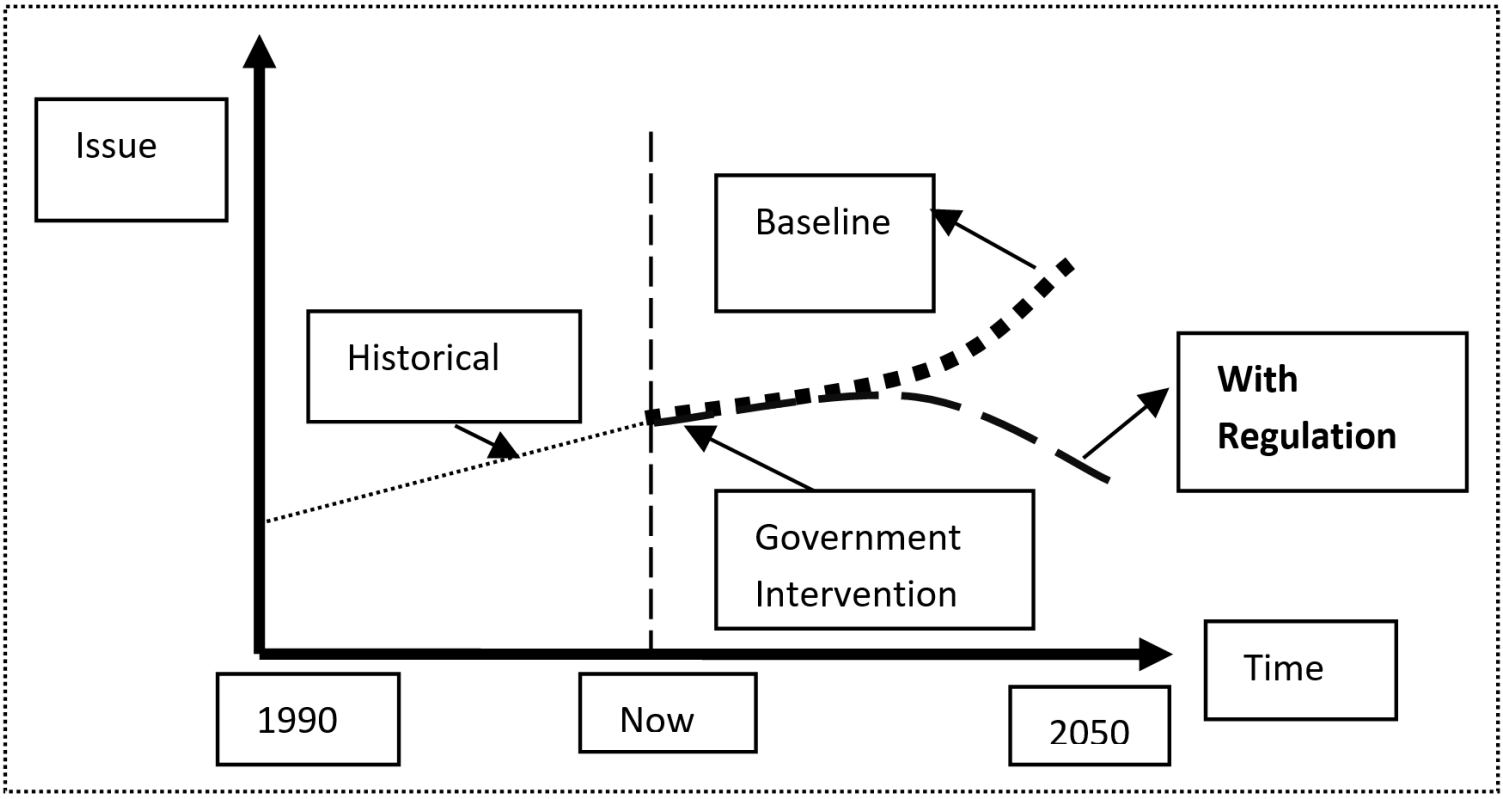
3.1 The baseline

Establishing the baseline is to define what is likely to happen in the future if government did not take the proposed regulatory action. The baseline is not a static historical account. Instead, it considers changes that are likely to happen under normal circumstances without the proposed regulation in place.

In CBA, it is necessary to isolate changes that would have occurred without the regulation in place. Essentially, the baseline acts as a control case so that the difference between the baseline scenario and the regulatory scenario(s) can be measured.

Figure 2 provides a possible graphical depiction of a baseline scenario and a regulatory scenario.

Figure 2. Comparison of a baseline scenario with a regulatory scenario



▶ Figure 2 - Text version

In order to establish a *baseline* scenario it is essential to:

- identify existing data and analysis to understand the nature of the issue, its risk and impacts in the absence of the regulatory proposal being considered;
- identify rules, practices, policies and requirements that currently exist;
    - for example, are some stakeholders already implementing some/all of the requirements of the proposed regulation (such as through best practices, or industry standards);
- analyze the industry trends both domestically and internationally;
- identify the factors and related uncertainties that are likely to change over time in the absence of the regulatory proposal; and
- given the uncertainties, consider whether the baseline scenario is the most likely and whether the CBA would benefit from more than one baseline scenario.

3.1.1 Baseline scenario: An example

Safe Food for Canadians Regulations

The Safe Food for Canadians Regulations (the Regulations or SFCR) aim to strengthen food safety by establishing consistent, prevention-focused requirements for food that is imported or prepared for export or interprovincial trade, and also includes some

requirements applicable to food that is traded intra-provincially. The Regulations consolidate 13 food commodity-based regulations plus the food-related provisions of the Consumer Packaging and Labelling Regulations (CPLR) into a single regulation under the Safe Food for Canadians Act (SFCA).

The Regulations contain 16 parts and include requirements with respect to the following: Trade; Licensees; Preventive Controls; Traceability; Commodity-Specific Requirements; Recognition of Foreign Systems; Ministerial Exemptions; Inspection Legends; Packaging; Labelling; Grades and Grade Names; Organic Products; and Seizure and Detention. The example below illustrates the baseline and regulatory scenario for only 2 requirements of SFCR – Traceability and Preventive Controls.

Traceability baseline

While many regulated parties in the food sector have implemented voluntary traceability systems, others do not have the necessary practices, including record-keeping to facilitate timely food safety investigations, recalls or withdrawals. The resulting information gaps within the food supply chain may lead to less efficient and inaccurate responses to a food safety incident. Currently, there are some traceability regulatory requirements for the fish and meat sectors.

Preventive Control Plan baseline

Some food sectors have implemented food safety plans, based on Hazard Analysis Critical Control Point (HACCP) principles, to demonstrate how they achieve compliance, for example, voluntary Food Safety Enhancement Program (FSEP) and Quality Management Program (QMP) which require maintenance.

3.2 The regulatory scenario(s)

The regulatory scenario provides information on the intended outcomes of the regulatory proposal, where the risk would be eliminated or reduced relative to the baseline. In some cases, there may be more than one regulatory scenario under consideration. In conducting CBA, departments and agencies should consider the regulatory scenario and its feasible alternative regulatory options.

In developing the regulatory scenario, CBA analysts may rely upon both policy documents, as well as draft regulatory text to ensure that the costs and benefits are appropriately

identified and attributable to the regulation and not to the enabling act or a related program (i.e., the costs and benefits of the regulatory scenario stem from requirements imposed by the regulation itself). In order to establish the regulatory scenario, it is essential to:

- describe and analyze the requirements the regulation will place on stakeholders;
    - determine whether affected stakeholders should be treated differently (e.g., will some stakeholders be exempted or subject to different requirements)
- identify the expected direct and indirect cost and benefits that will be assessed;
    - determine whether the direct and indirect costs and benefits are new or existing
- determine whether the analysis period is appropriate; and
    - identify the timing of the costs and benefits
- determine whether some of the activities, products or services face similar or differing requirements such as when some products have to be labelled while others have to be altered or when requirements are triggered at different dates.

3 2.1 The Regulatory Scenario: An Example from the *Safe Food for Canadians Regulations*

The regulatory scenarios for traceability and preventive control plans in the *Safe Food for Canadians Regulations* are described as follows:

Traceability: the regulatory scenario

The Codex Alimentarius Commission established by Food and Agricultural Organization of the United Nations (FAO) and the World Health Organization (WHO) in 1963, develops harmonized international food standards, guidelines and codes of practice to protect the health of consumers and ensure fair practices in the food trade. The international standard for traceability established by Codex Alimentarius calls for tracking of food commodities forward to the immediate customer and trace materials/food commodities backwards to the immediate supplier. The proposed regulations would apply the Codex standard to every stage of the food supply chain; from production to retail.

Preventive Control Plan: the regulatory scenario

Any entity that imports or prepares food commodities destined for inter-provincial trade would be required to develop, document, implement, and maintain a preventive control plan adequate to their activities. Additionally, anyone who prepares food for exports or

exports food who requires an export certificate would be required to have a preventive control plan.

A preventative control plan is a written document that sets out how food safety and other regulatory requirements would be achieved. It is a combination of control measures that, when taken as a whole, provide for a science-based approach to managing risks posed by hazards and contribute to achieving compliance to other regulatory requirements.

4. Step 2: Identifying, Estimating and Monetizing the Benefits and the Costs

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After establishing the baseline and the regulatory scenario(s), the next step is to identify the incremental costs and benefits associated with the regulatory option under consideration and any feasible alternative regulatory option. Costs and benefits should, to the extent feasible, be identified by stakeholder group. As such, a profile of stakeholders, including key information and data for each stakeholder group should be developed.

For businesses, the data may include:

- business size;
- contribution to Gross Domestic Product;
- employment;
- import and exports, and;
- investments.

For individuals, the data may include:

- population size;
- income levels;
- gender;
- age distribution;
- occupation;
- geographic distribution, and;
- any other relevant factor.

Regulations may involve costs to business, consumers and/or government, for example:

- capital costs to business to buy new equipment or retrofit existing equipment;
- labour costs to perform some of the activities required by the regulation;
- cost for material needed to comply with the regulation;
- direct financial costs such as fees;
- lost producer surplus;
- lost consumer surplus;
- restriction of consumer choice, and;
- enforcement costs incurred by any government etc.

In order to facilitate the identification of benefits and costs by stakeholder group, it is recommended that regulators develop a cost and benefit identification worksheet (Table 1) to organize the costs and benefits. The worksheet provides a list of the incremental costs and benefits, which should be ranked in order of their significance. The list will help identify the data needs, the methodology, as well as determine the analytical effort that will be needed. The worksheet could also be used as a tool to interact with stakeholders, as well as departments and agencies that have an interest in the regulatory proposal.

Table 1. Incremental Costs and Benefits Identification Worksheet

Benefits	**Stakeholder**	**Qualitative**	**Quantitative**	**Monetized**	**Rank the benefit**	**Regulatory requirements**	**Potential data sources**
What is the type of benefit?	Which stakeholders benefit?	Describe the benefit	Can the benefit be quantified?	Can the benefit be monetized?	How significant is this benefit likely to be?	Describe the regulatory requirements related to this benefit	Identify the data sources for the benefit
Costs	**Stakeholder**	**Qualitative**	**Quantitative**	**Monetized**	**Rank the cost**	**Regulatory requirements**	**Potential data sources for quantitative analysis**
What is the type of cost?	Which stakeholders will incur the cost?	Describe the cost	Can the cost be quantified?	Can the cost be monetized?	How significant is this cost likely to be?	Describe the regulatory requirements related to this cost	Identify the data sources for the cost

Stakeholders are often in a position to provide relevant information and data on the likely costs and benefits of the proposed regulation given their knowledge and experience with the product, service, and activities being regulated, as well as the technical, operational and business dimensions of the firms and of the industry. As such, it is useful to engage stakeholders to ensure that all significant cost and benefits have been identified. For effective engagement, stakeholders may need to have information on the regulatory options under consideration.

4.1 Standing: whose costs and benefits are to be considered in CBA?

As stakeholder groups are identified, it is important to determine whether those groups have standing (i.e. whether their costs and benefits should count). The Organisation for Economic Co-operation and Development (OECD) [1]'s recommendation on standing is that "*the basic rule is that benefits and costs to all nationals should be included, whilst benefits and costs to non-nationals should be included if a) the policy relates to an international context in which there is a treaty of some kind (acid rain, global warming), or b) there is some accepted ethical reason for counting benefits and costs to non-nationals*".

For the purpose of this guide, costs and benefits that are in scope are those that are attributed to "Canadians" defined as the Canadian community as a whole. This includes Canadian citizens, Canadian institutions (i.e., orders of government, Indigenous groups, businesses and non-government organizations), as well as individuals residing in Canada (i.e., permanent residents, temporary residents, refugees in Canada and temporary foreign workers) as all these groups may be impacted by the proposed regulations. In cases where Canadians value the impacts on non-residents or other countries, those benefits or costs should be included in the CBA based on the value that Canadians place on those benefits or costs. For example, money transfer regulations such as the *Money Laundering and Terrorist Financing Regulations* may decrease the amount of funds transferred to underdeveloped countries resulting in more poverty and less economic growth. If Canadian value reduction of poverty in less developed countries, the increased poverty that may result from money transfer regulations should be included in the CBA at a cost determined by the value Canadians put on poverty reduction.

Determining whether a business entity is Canadian

In a global economy, it can be difficult to determine whether a business entity is Canadian. To make this determination, one approach is to consider whether the business activity is done regularly or continually, as per the *Income Tax Act* and based on the Canada Revenue Agency criteria. [2] [3] For example, the place where a contract is made is considered the decisive indicator of where business is carried out. When this factor is unclear, the location of the operations from which the profits arise is the deciding factor. In determining whether a non-resident business entity is Canadian, the courts have also considered the following factors:

- the place where agents or employees of the non-resident are located;
- the place of delivery;
- the place of payment;
- the place where purchases are made or assets are acquired;
- the place from which transactions are solicited;
- the location of assets or an inventory of goods;
- the place where business contracts are made;
- the location of a bank account;
- the place where the non-resident's name and business are listed in a directory;
- the location of a branch or office;
- the place where the service is performed; and
- the place of manufacture or production.

Determining which entities/groups/individuals should not be considered in CBA

If the costs or benefits of a regulatory proposal are associated with entities/individuals/groups whose activities are contrary to prevailing laws and regulations in Canada, standing can be denied, even if the entities/groups/individuals are Canadian. For example, regulations such as the *Money Laundering and Terrorist Financing Regulations* may result in costs to individuals or entities engaged in illegal activities. Such costs would not have standing.

Determining whether environmental global costs or benefits should be included in CBA

The issue of standing is of critical importance in the cost-benefit analysis of regulations related to greenhouse gas (GHG) emissions using the social cost of greenhouse gases (GHG), which is a monetary measure of the global damage attributable to a one unit incremental increase in GHG emissions. The monetized damage avoided through an

incremental reduction in GHG emissions due to a regulation is a measure of the global benefit of that regulation.

Under normal circumstances and consistent with the "standing" definition in this guide, global benefits are not typically included in cost-benefit analysis. However, no country can exclude any other from the benefits of climate change regulation, nor the costs imposed by climate change [4]. As such, including costs and benefits of GHC emissions reduction, calculated using the social cost of GHG, is appropriate in cost-benefit analysis.

4.2 Which benefits and costs are in scope?

Direct and indirect benefits and costs

Regulations will often impose direct compliance and administrative costs on affected stakeholders. Cost may include expenditures on equipment, material and labour incurred by stakeholders to comply with the regulation. Regulations may also result in costs to government to implement the regulations. In addition to costs, regulations will also provide benefits, such as improved health outcomes, improved safety, product varieties or increased park space for recreation. The direct costs and benefits are the main focus of the CBA because they provide a measurement of the direct impacts of the proposed regulation, i.e., those that are directly attributed to the intended outcome of the regulation.

In some cases, proposed regulations may also result in other costs and benefits that are not directly attributed to the intended outcome of the regulation, referred to as indirect costs and benefits. Indirect costs and benefits are defined in the literature [5] as the subsequent second or higher round effects that may occur in the regulated sector, and other sectors of the economy, as sectors adjust to the changed regulatory environment. It should be noted that the greater the degrees of separation between a proposed regulation and indirect impacts, the more difficult it may become to quantify and monetize those impacts.

For the purpose of CBA, indirect impacts can be important in providing decision-makers with information on impacts that may occur as a result of the proposed regulation, but which are not directly intended by the regulation. Strong empirical evidence linking the requirements of the regulation to such impacts is needed before attempting to quantify and monetize those impacts. TBS will assess inclusion of indirect impacts on a case-by-case basis, and whether there is sufficient information to include indirect impacts in the

main part of the CBA (and in its accounting statement) or reported in a separate chapter of the CBA.

Gross domestic product (GDP) multiplier effects

GDP multiplier effects are changes in GDP resulting from the incremental net positive or negative impact of the regulatory proposal. In essence, a regulatory proposal with a net benefit would provide more disposable income that is injected in the economy. The extent to which the economy grows is a measure of the multiplier and depends on the marginal propensity to consume. The reverse would be true for a net cost regulatory proposal.

Including multiplier effects in CBA critically depends on the state of resource use in the economy. For example, if the economy is functioning at full capacity, i.e. resources are fully employed, the resources required to implement the regulatory proposal will be available at the expense of other sectors, and as such, there is no additional benefit to the economy. In these cases, including the multiplier effect is inappropriate.

However, if the regulatory proposal does not result in an increase in competition for capital, labour and other inputs so that without the proposed regulation, resources in the economy would not be fully utilized, including the multiplier effect would be appropriate. Essentially, multiplier effects come about from the use of resources that would otherwise not be put to productive use under the baseline scenario.

Box 1. Multiplier effects in cost-benefit analysis

Unemployment rates, inflation rates and capacity utilization rates can be used to assess whether it is appropriate to include a multiplier effect. For example, capacity utilization in Canada averaged 82.50 percent from 1987 until 2015 with a recorded high of 87.60 percent in the first quarter of 1988 and a low of 71.60 percent in the second quarter of 2009. The unemployment rate in Canada averaged 7.72 percent from 1966 until 2015 with a recorded high of 13.10 percent in December of 1982 and a recorded low of 2.90 percent in June of 1966. The natural rate of unemployment in Canada has been estimated to be in the range of 6% to 7%. What this data suggests is that if a significant regulation was being considered in an economy with 70% capacity utilization rate or the unemployment rate significantly above 7%, multiplier effects would have to be included. This is not a frequent occurrence. If the economy is

depressed under the baseline scenario, governments will often intervene to boost economic activity. For these reasons, multiplier effect should generally not be included in the cost-benefit analysis.

Costs and benefits in related markets

A proposed regulation may result in price changes in the target sector or market and, as a result, demand for complements or substitutes in a related market may change. Deciding whether these impacts should be part of the cost-benefit analysis can be difficult. However, economic literature does provide clear advice on this question. Various authors [6] have concluded that omitting the effects in related market is often justified and does not lead to a significant bias in the estimates of costs or benefits:

- if changes in the target market due to a proposed regulation do not affect prices in related markets, impacts in these markets should not be considered if there are no distortions (taxes, subsidies, quotas, impediments to competition etc.) in these markets and the impacts in the primary markets have been measured;
- even when prices in related secondary markets change, as long as there are no distortions and the impact in the target market has been estimated using demand schedules that do not hold prices in the related market constant, impacts in this market do not need to be considered, and;
- when there are distortions in the secondary markets, impacts of a regulatory proposal in the secondary markets are relevant to the cost-benefit analysis. Even in this case, price changes in the target would have to be high to have a significant impact in the secondary markets. This will rarely be the case because most goods are neither strong substitutes nor strong complements. Omitting these impacts is unlikely to significantly bias the CBA estimates.

4.3 Time horizon

The costs and benefits of regulations unfold over time. The time horizon for the analysis (i.e., how far into the future should the costs and benefits be forecasted) must be determined. As a general principle, the time frame for the analysis should be a period of time long enough for both the major costs and benefits of the proposed regulatory options to materialize, but short enough that the forecast model remains credible.

The time horizon will therefore vary from regulation to regulation. Too short a period will underestimate the net impacts of the regulation, while too long a period will tend to overstate the net impacts. One recommendation from the literature [7] is that the period of analysis should include an end point that extends at least to the "temporal breakeven point (i.e., the time point at which the regulation has become cost-benefit justified in terms of current dollars). While no firm guidance can be provided on a standard duration, factors such as technological progress, socio-cultural trends, and future behaviors of affected stakeholders should be taken into account. For example, the speed of adoption of electric vehicles is likely to have influence on the period of analysis for regulations aiming to curb pollution from motor vehicles.

The present value of costs and benefits should be based on a minimum 10-year forecast starting from the time the regulation is implemented, unless the nature of the regulation dictates otherwise (e.g., the regulation may have a sunset clause of less than 10 years). The CBA should contain a justification for the choice of the time horizon for the analysis and the time frame selected should be the same for all options considered by the CBA to avoid bias.

4.4 Correcting market prices for distortions

If markets for the goods and services affected by the proposed regulation are competitive and not distorted by taxes or subsidies, their observed and projected market price and quantity can be directly used to measure welfare changes from proposed regulations. In this case prices reflect the opportunity cost of resources in the economy as well the value of the goods and services consumed. However, if the markets are not competitive or are distorted, prices of the goods or services need to be adjusted to correctly value the costs and benefits.

Taxes, subsidies, and fees

In Canada, the goods and services tax and provincial sales taxes are generally imposed on goods and services; hence, consumers pay more than market prices by the amount of taxes. In situations where consumers forgo their consumption of certain goods and services, they will be forgoing the value of the goods and services inclusive of taxes. The gross-of-tax values should be used to measure the benefits associated with changes in the level of consumption of the goods or services affected by the policy, as they reflect

consumers' willingness to pay for these items. This means for example that if a regulation will result in a price increase for consumers, the ensuing change in consumer surplus would be based not on the market price, but on the market price plus the relevant tax.

In other markets, the prices of goods or services supplied may be quite different from the resource cost of production due to subsidies or taxes. Suppose government provides a production subsidy to the producer as a fixed amount per unit of goods sold; in this case, the cost of producing this good on the margin will be measured by the market price plus the amount of subsidy received by the producer per unit. In addition, suppose a subsidy is provided to purchase intermediate inputs for the production, the resources paid for by the subsidy should be accounted for in the calculation of the resource cost of producing the product. Instead of a subsidy, if the intermediate inputs are subject to sales taxes, these taxes should be deducted from the production cost of the good unless businesses do not pay such taxes or can claim them as tax credits. Therefore, if the proposed regulation under consideration has an impact on these markets, the resource cost of production should exclude taxes but include subsidies.

Proposed regulations may require the payment of regulatory fees:

1. to pay for goods and services provided by the government;
2. to recover costs for programs that handle impacts of negative externalities from those who cause them (congestion fees, pollution charges); or
3. to share costs of implementation of the proposed regulations (inspection fees, processing fees, licensing fees). [8]

Fees are not transfers. They are the value of resources expended in meeting the requirements of the regulations. As such, they are included in the estimate of costs of the proposed regulation (i.e., they form part of the total compliance cost). In reporting, the cost should be attributed to whoever pays all or part of the cost they bear.

While fees should be considered in CBA, it can be difficult (at times) to identify a fee. The literature suggests fees satisfy the following [9]:

- the primary purpose is to regulate;
- the money collected is allocated only for the authorized purpose;
- there is a direct relationship between the fee charged and the service received by those who pay the fee or between the fee charged and the burden impact (such as the amount of pollution) produced by the fee payer.

This is broadly consistent with the *Service Fees Act,* which defines a fee as an amount - called a fee, charge, levy or by any other name and is payable for:

a. the provision of a service;
b. the provision of the use of a facility;
c. the conferral, by means of a licence, permit or other authorization, of a right or privilege;
d. the provision of a product; or
e. the recovery, in whole or in part, of costs that are incurred in relation to a regulatory scheme.

The *Service Fees Act* also requires reimbursement of part of the fee if performance standards have not been met, strongly suggesting that the funds from the fee are dedicated to the purpose for which the fee was put in place.

Labour markets

When the level of employment is affected by the regulatory proposal, then labour market externalities may be created. This is because the opportunity costs of the workers who either fill new jobs or are displaced from previous employment because of the proposed regulations are not necessarily the same as the market wages these workers receive. The main distortions in the Canadian labour markets are personal income taxes and Employment Insurance (EI) benefits.

The differences between the opportunity costs of employed labour and the market wage paid will vary with the type of skills required, labour market unemployment rates, and the duration of the jobs. The difference will be particularly important if the proposed regulations affect the employment level in temporary jobs, which generates incomes that are complementary to the income support provided by the EI system. The opportunity cost per month of labour employed in temporary jobs tends to be significantly higher than for permanent jobs. This is because in permanent jobs little or no EI will be claimed because the employers retain the same workers on a year-round basis. [10]

If the regulation significantly affects the labour market, a shadow wage should be used in lieu of the market wage. The shadow wage depends on the different types of unemployment [11]:

Table 2. Calculating the shadow wage under various employment conditions

Market labour situation	Shadow wage formula	Meaning of Variable
Full employment	W	• W : the market wage • ΔL: the regulatory project labour input required • Δu: the decrease in unemployment (number of units) • Δe: the decrease in employment i.e. number of people leaving their jobs to work in sectors impacted by the regulatory project • M: the opportunity cost of output forgone (measured by the wage) in the prior activity • N: the reservation wage i.e. wage to induce entry in the labour market • z: the relocation costs • d: relocation adjustment factor • u: the regional unemployment rate • t: the rate of social security payments and relevant taxes
Mild unemployment	$m(\Delta e/\Delta L) + zd$	
Dualistic labour market	$n(\Delta u/\Delta L) + zd$	
Strong involuntary unemployment	$W(1-u)(1-t)$	

Inflation, deflation, relative prices

Changes in prices over time may occur during the implementation of the regulatory proposal. It is a frequent question as to how these changes in prices should be dealt with in the cost benefit analysis. Projected increases in the general price level (inflation) or decreases in the general price level (deflation) should not be considered. The CBA seeks to estimate the incremental changes in real terms, e.g. how many more tons of organic apples, for example, are sold because of a regulation that creates a certification body for organic products?

The estimates of the costs and benefits will be biased if the general changes in prices are not excluded. During a period of rising inflation, allowance for inflation in the CBA will result in the overstatement of the benefits because they quite often occur long after the costs have been incurred. Allowance for deflation will result in an overstatement of the costs of the regulatory proposal because they tend to be incurred earlier in the implementation phase.

If there is a change in the real price of a product or a service, such price changes should be included in the CBA. For example, the price of some goods or services may experience a real decline during the period of analysis because of technological progress (information storage is an example), the lower price should be used in the analysis.

4.5 Estimating the Value of Benefits

The economic value of an item, service, or preferred outcome is associated with the benefit, or utility, derived from it. Value is measured in terms of exchange, meaning that the value of a good is signified by what someone is willing to give up to acquire it. Since currency is a universal unit of exchange, it is useful to measure value in dollars.

Although economic value is measured in dollars, it is not analogous to price. People who purchase a good, do so because they expect its value to exceed the price (the difference being consumer surplus). In general, economics assumes that each successive purchase of a good provides less value than the previous one. For instance, a person receives more value from the purchase of their first television than they do from their second, than from their third, and so on. A person will buy more of a good until the next unit's expected added value is less than or equal to the cost (price equal to value). For this reason, price is considered to approximate the additional value of one more unit of a good (the marginal value) and impacts can be estimated by the product of price and quantity. However, this is only true for marginal changes. In cases where a regulatory change may result in the complete removal of a product, then the market price would no longer be an accurate indicator of value for every unit of the good. In such cases more sophisticated analysis involving estimation of demand functions may be needed.

The goal of economic valuation is to estimate in dollar terms, often in the absence of a market, the net value of the benefits gained or lost from a particular choice. Some benefits, such as a price decrease resulting from a regulation, occur in the marketplace and are easier to estimate using market methods. Others, such as environmental, health, safety and security benefits, do not have a market. Estimating these types of benefits generally presents challenges because they have no specific identifiable market price since they are not traded. Yet, monetizing these non-market benefits is important to allow decision-makers to compare costs and benefits on a common basis, and enable them to choose the option that maximizes net benefits. Various analytical techniques have been developed to monetize these effects. These are based on two concepts: willingness-to-pay and willingness-to-accept. These methods are meant to measure the value of non-market outcomes.

Willingness-to-pay and willingness-to-accept

A measure of value that underpins the economic theory of value is willingness-to-pay (WTP). It is defined as the maximum amount an individual is willing to pay to acquire an outcome. It is essentially a measure of the value of particular attributes of the total economic value of a good. For example, if something is of value then people should be willing to pay for it. This concept applies both to non-market outcomes like air quality and to market goods. It is important to recognize that WTP as a measure of value is anthropogenic: its use assumes that outcomes only have value from the point of view of humans. If an outcome is not considered to impact humans in some way, by this measure, its value is zero.

There is considerable research on valuation that also deals with the concept of willingness-to-accept (WTA) and how it differs from willingness-to-pay. Willingness-to-pay attempts to measure how much a person would pay to receive a beneficial outcome, whereas willingness-to- accept measures how much a person would accept (in compensation) for a negative outcome. For instance, revealed preference based on wage-risk studies, to be discussed later in this guide, is based on willingness-to-accept not willingness to pay. While theoretically the two concepts are distinct, in this guide the term "willingness-to-pay" will be used to refer to both. However, the two can be perceived very differently, especially when changes are extreme or when a given state has come to be considered as an entitlement.

While many consider willingness to pay to be a method for measuring value, this is incorrect. Willingness-to-pay is what is being measured, the value of a particular trait of an outcome, not the method. The methods that are used to measure value, often as represented by willingness-to-pay, are discussed in further detail in the following section.

4.5.1 Market methods

In competitive markets, market prices for goods or services essentially show the willingness-to-pay for a good or service (at the margin), thus providing direct data for estimating benefits and costs. However, estimation is more challenging for most environmental, health, safety, and security initiatives because of the absence of markets. Examples include control of air and water pollutants; privacy; and gun control for safety and security. Nevertheless, a variety of techniques have been developed to value these goods or services in a manner consistent with the valuation of marketed goods. The

revealed preference, stated preference and transfer methods used to quantify the benefits of non-market goods and services are discussed briefly below.

4.5.2 Revealed preference methods

These methods estimate the values placed on health, the environment, and other goods using data obtained by observing actual choices made by individuals in related markets. From this information, the analyst can infer the value of the regulatory impact being considered. The following are general applications of some of these methods, but their application should be determined on a case-by-case basis.

The hedonic price method

The hedonic price method estimates the value of a non-market good, such as noise, by observing behaviour in the market for a related good. It relates the price of a marketed good with a bundle of characteristics or attributes associated with the good. For example, the price of a car is a function of size, fuel efficiency, safety, comfort, noise, and reliability. Such a relationship expressed as a hedonic price function can be estimated using econometric techniques. Once the functional relationship is established and coefficients are estimated, the implicit or shadow price of a characteristic can be obtained by partial differentiation. This allows the estimation of a demand curve for a characteristic of interest.

This method has been applied to labour and property markets for measuring the benefits of various regulatory improvements. [12] The former is based on the premise that individuals make trade-offs between higher wages and occupational risks of injury or death. The key lies in separating the portion of compensation associated with occupational health risks from other job characteristics, including managerial responsibility, job security, and other factors. The outcome of these models is an estimated value for small changes in mortality or morbidity risks. The key assumption is the provision of perfect labour markets in which workers are mobile and there is perfect information available regarding jobs and job risks.

The other application of the model is for the estimation of property values. Under this approach, the value of a house is a function of its location, size, age, proximity to amenities, and property tax as well as other factors such as the noise level in the neighbourhood, the quality of local schools, crime rates and other relevant characteristics.

When sales are made, individuals make trade-offs among these attributes and reveal their implicit prices. Using statistical techniques, one can estimate the implicit value of each of the attributes and use them to derive the overall value of any given property based on the amount of each one of its attributes.

This method has been used to estimate the value of non-market goods such as air pollution, water quality, and road traffic. Nevertheless, care must be taken where a good can have several intangible attributes. If the attributes included as explanatory variables are closely correlated with each other, coefficient estimates can be biased. Multi-collinearity can also bring instability to the parameter estimates and, if serious, can reduce the confidence attached to model predictions. Other problems with the hedonic price method include omitted variable bias and wrong choice of functional form. Analysts must decide which characteristics to include as explanatory variables; omitting a characteristic that has a significant impact on the market good can lead to biased coefficient estimates. Additionally, analysts must decide on the functional form for the hedonic price function. Another related problem might be the inclusion of irrelevant variables in the regression model. Avoiding inclusion of irrelevant regressor(s) will increase the degrees of freedom and, as a result, will enhance the precision of the estimation.

The travel cost method

The travel cost method seeks to place a value on non-market environmental goods by using consumption behaviour in a related market. Specifically, the costs of consuming the services of the environmental asset are used as a proxy for price. This method has been used for valuing recreational premises. The recreational activity is a non-market good. The demand (willingness- to-pay) for a recreational activity is estimated based on the relationship between the number of trips taken by individuals/households and their travel costs. In this approach, travel cost, represented by both travel time and expenses, is a proxy for 'price' of the activity, and the estimated demand schedule is simply the quantity demanded at different prices. The estimated willingness-to-pay only measures user value. The latter usually includes (a) the transportation costs in air fares, taxis, fuel, wear of tires, depreciation of vehicles, etc. and (b) the costs of time spent on travelling. In the cost-benefit analysis, time spent on travelling should be measured by the opportunity cost of time for the driver and passengers. Related trip expenditures on accommodation, equipment related to the recreational activity and permits, etc., purchased to enable an individual to take part in the activity should also be included when calculating the value.

Averting behaviour method

The averting behaviour method is similar to the travel cost method but differs to the extent that it infers values from observing how individuals change their behaviour in response to changes in the quality of the environment, health, or safety. For example, willingness to pay to reduce mortality risks can be estimated by observing the amount of money spent on averting activities such as the purchase of safety equipment to reduce the risk of accidental death. Similarly, the value of a quiet location may be estimated by what people are paying to install double-glazed noise reducing windows.

Cost-of-illness method

Cost of illness measures include the savings related to medical treatment avoided and income lost from worker productivity, often referred to respectively as direct and indirect costs of medical treatment. Direct costs measure the resources used for treating a particular illness (medical treatment), whereas indirect costs measure the value of resources lost due to a particular illness (lost work days). These measures exclude the benefit derived from less pain and suffering, associated with improved health and avoiding negative health effects. Therefore, cost of illness alone does not reflect the total value of an adverse health effect and understate the value of avoiding negative health impacts. However, cost of illness measures have the practical advantage of being easily understood and often more readily available, because they are based on market expenditure data and readily available medical statistics.

Cost-based approaches

The damage cost avoided, replacement cost, and substitute cost methods are related methods that estimate values of ecosystem services based on either the costs of avoiding damages due to lost services, the cost of replacing ecosystem services, or the cost of providing substitute services. These methods do not provide strict measures of economic values, which are based on peoples' willingness-to-pay for a product or service. Instead, they assume that the costs of avoiding damages or replacing ecosystems or their services provide useful estimates of the value of these ecosystems or services. This is based on the assumption that, if people incur costs to avoid damages caused by lost ecosystem services, or to replace the services of ecosystems, then those services must be worth at least what people paid to replace them as long as they are incurred voluntarily. Thus, the methods are most appropriately applied in cases where damage avoidance or

replacement expenditures have actually been, or will actually be, made. When both the willingness-to-pay and the cost of avoidance measures are available, the less of the two should be used.

Production function method

The value of a natural resource can be monetized based on its value as a factor of production where those resources are used in the production process of goods and services sold in markets. The output of any firm is the function of several important inputs (e.g., land, capital, natural resources), collectively known as factors of production. These factors are used in the production of other goods. When a natural resource has direct value as a factor of production and the impact of environmental degradation on future output of that resource can be accurately measured, the resultant monetary value of the decline in production, or higher cost production, can be measured.

4.6 Stated preference methods [13]

Stated preference methods refer to a direct survey approach to estimating the value placed on non-market goods or services. They rely on information obtained through surveys rather than on the indirect valuation through revealed preference methods. This approach attempts to measure the WTP directly through surveys that ask respondents about their evaluation of changes in the level of environmental quality, health, and safety. These surveys differ from public opinion research surveys which are intended to gauge public attitudes and opinions on a subject. WTP surveys are used when market price data is not available and revealed preferences approaches are inadequate. They help provide an accounting of benefits and costs of a regulatory change.

The most common application of these methods is contingent valuation. [14] The contingent valuation method does not require the public goods or services to be linked to actual market transactions. It asks respondents in a hypothetical market if they would pay a specified amount for a prescribed commodity. The approach has gained increased acceptance among many academics and policy makers as a versatile and powerful technique for estimating the monetary value of non-market impacts of regulatory initiative.

While conducting the studies and surveys, the following principles and steps should be considered:

- a pilot survey is important to finalize the construction and design of the questionnaire;
- the survey should be conducted within an acceptable length for a typical interview in order to collect adequate information and reduce refusal rates from respondents;
- the good or service being evaluated should be clearly explained to the respondent, as well as the objectives of the study;
- the socio-economic and demographic characteristics should be part of the questionnaires in order to cross-check the respondent's WTP;
- in order to credibly measure willingness-to-pay, questions should be designed in such a way as to take into account the budget constraints and capacity of the surveyed population;
- the selection and size of the sample should be stratified or clustered according to proper sampling techniques;
- statistical adjustments to the results should be made to account for non-response bias, if any; and
- statistical analysis should be transparent and properly documented.

Surveys can be conducted either by mail, by telephone, through the internet or in-person. In-person interviews are generally the most reliable. However, they are also expensive and time-consuming. In some cases, direct interviews are essential due to the complexity of the questions or communications capabilities of households. Mail and telephone surveys are significantly less expensive to carry out, but the quality of both the responses and the analysis that can be performed using these results is lower.

When the value of the impacts on non-market goods cannot be found using revealed preference methods, the use of stated preference methods is one of the simplest ways to obtain estimated values. Thus, the technique has been widely used in valuing air and water quality, outdoor recreation, cultural heritage sites, improvements in public education, and the health effects of pollution. It is, however, worth noting that respondents may not be entirely objective in their responses to questions because of the hypothetical nature of the market and the description of the public goods in question may cause biases in the estimation of people's WTP. There are at least three potential biases that may be encountered in a contingent valuation method. First, strategic bias may arise when a respondent thinks he or she is able to influence a policy decision by not answering the questionnaire honestly. Second, a respondent may be unsure of a specific price (i.e. starting-point bias) he or she is willing to pay. Third, a respondent may not fully

understand the questionnaire or the question posed by the interviewer. Thus, concerns are often raised about the validity and reliability of the findings of contingent valuation studies. Care must be taken in the design and implementation of such surveys so that any biases are minimized.

In addition to contingent valuation, there has been a growing interest in conjoint analysis or choice modelling approaches. This technique is considered a family of survey-based methodologies for modelling preferences for goods where goods are expressed in terms of their attributes and the categories of these attributes. Respondents are asked to make a choice of a good based on the preferences for the types and levels of the attributes associated with the good. The amount of WTP can be estimated indirectly from the prices of the relevant attributes of the good being valued. [15]

4.7 Benefits transfer methods

If a direct estimation of the benefits for the specific situation is too difficult or will take too much time, then one may try to draw upon existing valuation estimates made by others in similar circumstances. This process of applying values drawn from existing analysis to new options is called benefits transfer.

The benefit transfer method relies on information from existing studies that have applied these non-market methods of valuation. This is in fact using the value of a good or service in an existing study as a proxy for the value of the same good or service in another study. An example of a benefits transfer database is the Environmental Valuation Reference Inventory (EVRI). [16]

This method has been widely used in both the fields of health and environmental valuation. In applying these methods, it is important to identify appropriate studies that are relevant for the policy. [17] Estimates derived using benefit transfer techniques are likely to differ from the estimates that would obtain from a direct estimation of the impacts of a regulatory change. Thus, the analyst should review and assess the existing studies for their quality and applicability to the case under examination and determine whether the studies are suitable. It is important to make adjustments for any important differences between the circumstances of the existing studies and those of the situation being evaluated.

The following basic steps should be undertaken in selecting benefit transfer studies for use:

- the selected case studies should be similar to the policy case in terms of the good or service in question and socio-economic conditions, including the size of population, demographic characteristics, economic conditions, value judgment, etc.;
- the selected studies should be based on their comprehensiveness and quality of data, sound theoretical concepts, and careful analysis of empirical results; and
- the welfare measures (WTP / willingness-to-accept (WTA)) should be comparable to the policy case.

As a general rule, transferring unadjusted values of benefits from the selected studies to the policy option is rare because the underlying conditions may not hold. The commonly used adjustments for transferred benefits in determining WTP include changes in income per capita, changes in age structure, changes in population density, and levels of education. Adjustments can be made in either the point transfer or a function transfer expressed as a function of various relevant characteristics. In adjusting values, one should take into account the following factors:

- difference in the income of the affected populations;
- difference in population size or density between the two regions;
- social or demographic differences between the two populations;
- differences in the size/magnitude of the change in goods or services;
- differences in the baseline; and
- other factors that could reasonably result in differences in WTP between the two values.

4.8 Valuation of impacts on human health

Regulations may affect human health in a number of ways. They may save lives by reducing the risk of mortality. They may also improve the health of those living with diseases, i.e. there may be a morbidity benefit. Other benefits may include some reduction in tension or stress, or an improvement in mental health. Individuals are willing to pay if improvements are made in each of these areas. The question is how one can place a value on the improvements, and by how much.

Value of statistical life (VSL)

Regulations on health and safety generally are expected to reduce the risks of premature death. The benefits of these risk reductions are usually measured in terms of the value of statistical lives (VSL). VSL is not a value put on any identifiable human life. Rather, it is an aggregation across individuals, over an exposed population, of each one's willingness to pay estimates for a small reduction in mortality risk. Mortality risks can be classified across two broad dimensions: the characteristics of the affected population and the characteristics of the risk itself, such as timing. Because original research is usually very resource and time-intensive, analysts may draw from existing VSLs that have been estimated using well-established methods.

The United States Environmental Protection Agency (2000), Chestnut et al. (1999), the Australian Government (2008) [18] and the OECD [19] did extensive literature reviews of VSL studies. [20] Out of 26 policy-relevant risk VSL studies, the United States Environmental Protection Agency recommended a central risk VSL estimate of US$6.1 million in 1999 dollars. The risk VSL estimates range from a low US$0.7 million to a high US$6.3 million. In a report prepared for Environment Canada and Health Canada, Chestnut et al. (1999) did an extensive literature review of previous VSL studies. They found a mean VSL of $5.2 million with a range from a low of $3.1 million to a high of $10.4 million in 1996 dollars. The Policy Research Initiative (2009) updated the study by Chestnut et al. (1999) and found the average VSL to be $6.5 million [21] in 2007 Canadian dollars. Departments and agencies are expected to use this value as the VSL in their cost-benefit analysis. Departments and agencies can convert this VSL to their chosen price year using the Statistics Canada Consumer price index.

A morbidity benefit is the reduction in the risk of non-fatal health effects that can be characterized by duration and severity. The preferred measure for morbidity benefit is WTP to reduce the risk of getting ill. This measure includes the direct costs of medical treatment and the indirect costs of pain, suffering, time lost for work and other leisure activities imposed by an illness.

While the VSL is a well-accepted term among economists and the methodologies uncontroversial, the language and terminology associated with the VSL has caused confusion and significant misunderstanding about what is being measured, and can lead to arguments that undermine the credibility of the analytical approach. As a consequence, there are ongoing efforts to move away from use of the term "value of statistical life". Terms such as "marginal value of risk reductions", the "the value of reduced mortality

risks", or the "value of a micro mort reduction" are being increasingly used in the literature and in CBAs. Some countries (the U.S. for example) are formally exploring the use of the Value of Mortality Risk (VMR) as a replacement for the VSL. These two concepts differ in the units used. The VMR is expressed in terms of dollars per unit of risk reduction per person per year. For a regulation that reduces risk by one in a million with a willingness to pay (WTP) of $6.5 per 1 in a million risk reduction and an affected population of one million, the VMR would be calculated as $6.5*1M people *1 unit risk reduced. This yields the same value as the VSL formula i.e. WTP/ risk reduction or $6.5/ (1/$1M)

Value of a Statistical Life-Year (VSLY)

Some have suggested that while value of a statistical life is relevant for acute deaths, for mortality as a result of chronic health effects, the value of a statistical life-year may be more relevant [22]. This is due in large part to reservations about the appropriateness of transferring estimates of the value of a statistical life from studies based largely on workplace accidents, which typically represent healthy, middle-aged adults, to an environmental context. Someone with 35 years of expected life remaining who faces an immediate risk would tend to value that time differently than would an older individual with less expected remaining life.

To account for this, the method used for valuing a statistical life-year estimates the life-years that would be lost if an individual were to die prematurely. In its simplest form, the method derives estimates of the value of a statistical life-year from the value of a statistical life. The underlying premise is that a value of a statistical life is the aggregation of a stream of constant annual values for the remaining expected years of life of an individual. In this interpretation the estimate of the value of a statistical life-year depends on three factors: the underlying estimate of the value of a statistical life, a discount rate, and the number of years of life remaining. It has been suggested that many wage-risk studies are based on individuals with an average life expectancy of an additional 35 years. [23] Using the 35-year life expectancy and an estimate of $5 million as the value of a statistical life, this approach yields an estimate of $143,000 per life-year given a zero discount rate. If a discount rate of 5% is used, then the $5 million value of a statistical life translates into a value of a statistical life-year of $305,000. In this method, the estimated value of a statistical life is assumed to already be a discounted value, and thus the higher the

discount rate underlying the value of a statistical life, the higher the derived value of a statistical life-year.

Quality adjusted life years (QALY)

Another methodology which is relevant to the valuation of the impact of regulations on morbidity, is QALY (quality adjusted life years). [24] QALY is a measure of health outcomes, which is the arithmetic product of life expectancy and a measure of the quality of the remaining life-years. It assigns each period of remaining life a weight, [25] ranging from 0 to 1, corresponding to the quality of life during that period, where 1 represents perfect health and 0 proxies a health state judged equivalent to death.

QALYs are used as a measure of health outcomes in evaluating various health interventions in terms of their costs and consequences. The value of an intervention that affects quality of life and/or longevity is measured as the difference in QALYs between the two conditions: with and without the intervention. Estimates of QALYs for a wide range of diseases and treatments have been made by the World Health Organization and Health Canada.

As a measure of health outcome, QALYs can simultaneously capture gains from reduced morbidity (quality gains) and reduced mortality (quantity gains), and combine these into a single measure. While QALYs do not provide a monetary estimation of health outcomes, they make it easier to compare the effectiveness of interventions with different health outcomes.

4.9 Social cost of greenhouse gases

The social cost of greenhouse gases (GHGs) are measures of the incremental additional damages that are expected from a small increase in GHG emissions, or conversely, the avoided damages that are expected from a decrease in GHG emissions. Environment and Climate Change Canada in collaboration with the Interdepartmental Working Group (IWG) on the Social Cost of Greenhouse Gases describes the methodology they used to determine the appropriate social costs of the various greenhouse gases.

When measuring the costs and/or benefits associated with changes in greenhouse gas emissions, departments and agencies must use the social cost of carbon, the social cost of methane (SCCH4) and the social cost of nitrous oxide (SCN2O) as determined by

Environment and Climate Change Canada in collaboration with the Interdepartmental Working Group (IWG) on the Social Cost of Greenhouse Gases.

4.10 Administrative costs or burden relief

One internationally accepted approach to measuring administrative cost is the Standard Cost Model (SCM). The SCM estimates the costs of completing each administrative cost activity on the basis of price (P) and quantity (Q).

The price (P) consists of:

- the tariff or wage (hourly) costs plus overhead for administrative activities [26] done internally or hourly cost for external service providers, and;
- the amount of time (in hours) required to complete the administrative activity.

The quantity (Q) comprises of:

- Population or the number of stakeholders affected, and;
- Frequency that the activity must be completed each year.

Combining these elements gives the basic Standard Most Model formula to compute the *administrative burden impacts of an administrative burden activity* as:

- Price * Quantity = (tariff*time) * (population*frequency).

The aggregate administrative cost is the sum of individual activities' administrative costs for all stakeholders.

4.11 Estimating Costs

In CBA, opportunity costs rather than market prices should be used to value impacts. The opportunity costs are the value of the option not taken. For example, the opportunity cost of doing graduate school includes the cost of the graduate schooling itself and the foregone salary that one would earn with an undergraduate degree. It is the opportunity costs that are the resource costs to be used in a cost-benefit analysis. Thus, suppliers of the project's output will be indifferent between selling incremental units of the good at their supply prices or using it as factors to produce other goods and services. For example, most, if not all, capital equipment is traded goods. Their cost should be measured by their prices net of all import tariffs, sales taxes, and excises. [27] This is because the tariffs, sales taxes, and excise imposed on the equipment are considered transfer payments and

thus are not a net cost to society. More generally, costs that do not involve use of actual resources should not be included in the CBA. These include interest payments on capital, transfer payments and depreciation allowances.

The presence of externalities creates a wedge between market prices and the actual social cost. For example, absent government action, producers will not take into account the cost of pollution in their production decisions. As such, CBA uses marginal social cost and marginal social benefits which account for the value of externalities.

The previous section considered the incremental benefits of the regulatory scenario(s) as compared to the baseline scenario. This section considers the other side of the equation, i.e. the incremental costs of each of the regulatory options as compared to the baseline scenario.

The costs are the value of the resources used as a consequence of the implementation of the regulatory proposal. Costs can be both direct and indirect. Direct costs include compliance costs and administrative costs incurred by stakeholders including individuals, businesses, governments and non-profit organizations. Ancillary costs include the adverse impacts that a regulatory proposal may have on innovation, competition, productivity, trade, etc.

Treatment of sunk costs

There are times when a regulation results from an approved policy approach in which funding is identified to allow departments and agencies to implement the regulation. These expenditures are approved with the full knowledge that they are in anticipation of the implementation of a regulation. For such regulations, departments and agencies should provide in the CBA, estimates of total costs including costs already incurred (e.g., costs to develop an IT system to support implementation of a regulation) to provide a full picture of the cost of the regulatory proposal. As sunk costs are irrelevant in the decision to approve or not approve a regulatory proposal, departments and agencies should also provide estimates of total costs going forward i.e. excluding costs incurred before the regulation was made to inform decision-making.

Use of estimates from Treasury Board submissions in the CBA

When it is anticipated that a regulatory change will require significant resources for its implementation, departments or agencies may forecast the funding needed as part of a

Treasury Board funding submission. These forecasts can be used in cost-benefit analysis under certain conditions. They have to be:

- incremental costs;
- directly attributable to requirements in the regulation;
- be based on the opportunity costs principle; and
- may not include excluded cost such as transfers, depreciation allowances and interest payments on capital etc.

5. Qualitatively analyzing the costs and benefits

In some cases, costs and benefits cannot be quantified and/or monetized, as such, a rigorous qualitative description of the proposal must be done by:

- listing and subjectively ranking important impacts that cannot be quantified or monetized;
- providing a detailed justification as to why the identified costs or benefits could not be quantified or monetized; and,
- providing a descriptive analysis of the costs or benefits that could not be quantified or monetized including:
  - the strengths and limitations of the qualitative information;
  - a description of the timing and likelihood of such impacts;
  - a discussion of the size of the affected sectors in terms of variables such as employment, investments, value added or number of people or entities involved;
  - a comparison with similar analysis in other jurisdictions; and,
  - a review of the literature.

6. Step 3: Comparing Benefits and Costs

▶ In this section

6.1 Discount rates

For each regulatory option under consideration, the costs and benefits will usually not occur in the same year, but are spread over several years. Costs and benefits must be discounted to account for time preferences (consumption today is preferred to

consumption in the future) or the time value of money (people prefer to make payments later and receive benefits sooner).

The costs and benefits should be expressed in terms of the price level of a specific year. In this way, the changes in the reported values of benefits and costs over time that are due purely to inflation are removed.

Discount rates for Canada (i.e., real rate of 7% and social rate of 3%)

When a program requires funds that are extracted from the capital markets, the funds are drawn from three sources. First, funds that would have been invested in other opportunities have now been displaced by expenditures required by the regulatory action. The cost of these funds is the return that would have been earned on the alternative investments. Second, funds come from different categories of savers in the country who postpone their consumption in the expectation of getting a return on their savings. The cost of this part of the funds is reflected in the interest rate that the savers earn net of personal income tax. Third, some funds may come from abroad, that is from foreign savers. The cost of these funds would be the marginal cost of foreign borrowing. At the margin, the cost associated with incremental foreign borrowing is measured by the interest expense on the incremental borrowings plus the marginal change in the cost of foreign borrowing times the quantity of the stock of foreign debt negotiated at variable interest rates.

The discount rate will be a weighted average of the costs of funds from the three sources outlined above: the rate of return on postponed investment, the rate of interest (net of tax) on domestic savings, and the marginal cost of additional foreign capital inflows.
The weights are equal to the proportion of funds sourced from domestic private-sector investors, domestic private-sector savers, and foreign savers.

Based on the above approach, the discount rate for Canada was re-estimated by Jenkins and Kuo (2008). It is found to be a real rate of approximately 7 per cent [28]. Over time, the effective rate of corporate income tax in Canada has been steadily decreasing. Furthermore, the introduction of the goods and services tax and the harmonization of some provincial sales taxes with the goods and services tax have removed much of the burden of the sales tax system from the value added of capital. Both these policy changes will tend to lower the required gross of tax rate of return on capital. A real rate of 7 per

cent is to be used as the discount rate for the cost-benefit analysis of regulatory proposals in Canada.

In certain circumstances (such as certain human health and environmental goods and services), some federal departments, governments, and international organizations have taken into consideration factors other than the economic opportunity cost of funds when developing their recommendations for the value of the discount rate. In these circumstances, the analysis can be carried out using a social discount rate. Usually these social discount rates are lower than the 7 per cent real rate. One approach is to estimate the social time preference rate, which is based on the rate at which individuals discount future consumption and projected growth in consumption. For Canada, the social time preference rate has been estimated to be around 3 per cent, see Box 2. Regardless of the rate used, the costs and benefits must be discounted using the same rate.

Box 2. Calculating the Social Discount Rate

The basic formula used to compute the social discount rate was initially derived by Ramsey [1] and has since been used by various authors [2].

$SDR = p + eg = d + l + eg$

Where:

- p = the rate at which society discount future utility (utility discount rate).
- d = pure time preference of individuals
- l = life chances estimated as death/total population
- e = elasticity of marginal utility of consumption relative to time
- g = Real projected growth rate in per capita consumption

It is clear that the value of the social discount rate critically depends on the estimated values for *d, l, e* and *g.* The following estimates are used to compute the Social Discount Rate:

Parameter	*(d)* Lower Bound	*(d)* Middle Range	*(d)* Upper Bound
d	0	0.25%	0.5%
l	1%	1%	1%
e	1.30	1.30	1.30

g	1.2%	1.2%	1.2%
SDR	1%+1.6%= **2.6%**	1.25%+1.6%= **2.85%**	1.5%+1.6%= **3.18%**

1 Ramsey, F.P. (1928), "A mathematical theory of saving", *Economic Journal,* Vol.38, pp.543-59.

2 David J. Evans and Haluk Sezer. 2005. "Social discount rates for member countries of the European Union." *Journal of Economic Studies,* Vol 32, 2005, pp 47-59.

3 Government of Canada, Policy Research Initiative, *Social Discount Rates for Canada*, paper prepared for the Treasury Board Secretariat, Ottawa, May 2007.

6.2 Net present value

Once the incremental benefits and costs have been quantified in monetary terms, they are discounted using the discount rate and the net incremental present value is calculated as the difference between the discounted benefits and discounted costs.

The discounted present value of net benefits is the algebraic sum of the present values of the expected incremental net benefits of the policy option over and above the baseline scenario during the policy's anticipated impact time period. If the net present value (NPV) is greater than zero, then the policy is expected to generate more benefits than costs.

The formula for NPV is the following:

$$NPV = \sum_{t=0}^{n} \left(B_t - C_t\right) / \left(1 + r\right)^t$$

Where:

B = benefits
C = costs
r = discount rate
t = year
n = total number of years

Another criterion is the cost-benefit ratio. Although the criterion is widely used, it is highly problematic especially when used in a regulatory policy analysis where one is choosing from strict alternatives. The main problem is that it does not consider the scale of the outcomes involved i.e. a regulation that results in more benefits per dollar spent will

appear to be preferred to a regulation with larger total net benefits but with lower benefit per dollar spent.

6.3 Annualized costs and benefits

The CBA should report both the total costs and benefits, as well as the total net benefits. CBA results for multiple and mutually exclusive regulatory options with different time horizons, should always be presented in terms of annualized values to permit a meaningful comparison of the options in addition to providing the total costs and benefits for the various regulatory options. This comparison requires significant diligence as differences may be due to assumptions, modelling strategies and other factors such as the quality of the data. These should be noted to ensure that the basis of comparisons are understood.

To annualize the net benefits of a policy, the following relationship holds between the present value of net benefits over the *n* policy impact periods and its annualized value: [29]

$$AV = [NPV \cdot r]/[1 - (1+r)^{-n}]$$

Where:

AV = annualized value of net benefits over the n periods;
NPV = present value of net benefits over the n periods;
r = economic discount rate; and
n = duration of the policy impact periods.

Box 3. Example: Annualized costs and benefits

Suppose there are two mutually exclusive projects. Project A generates a present value of net benefits of $1,500 million over a five-year period. Project B generates a present value of net benefits of $1,700 million over a seven-year period. With the simple net present value criteria, Project B would be recommended. However, we have problems with a longer time horizon than that of Project A.

We can calculate the annualized value of the net benefits as follows:

For Project A, the annualized value of the benefits is:

$$AV_A = [1{,}500 \bullet 0.07] / [1 - (1 + 0.07)^{-5}] = \$365.8 \text{ million}$$

For Project B, the annualized value of the benefits is:

$$AV_B = [1{,}750 \cdot 0.07] / [1 - (1 + 0.07)^{-7}] = \$324.7 \text{ million}$$

Conclusion: The higher present value of the net benefits for Project B than for Project A is due to a longer time horizon. When the value of net benefits is normalized with respect to time period, it is shown that Project A is in fact preferred.

6.4 Cost-effectiveness analysis [30]

Cost effectiveness analysis is used when there are benefits (effectiveness measure) that are quantified, but not monetized. The approach is useful when more than one option is being considered and the regulatory options under consideration yield one predominant type of benefit - or the quantified benefits that can be meaningfully aggregated. Analysis of regulatory impacts (costs and benefits) are calculated relative to the baseline i.e. they are incremental. The approach followed depends on whether the options are independent (mutually exclusive) i.e. the cost and the effective measure of implementing one option are unaffected by the implementation of other options. In this case, average cost effectiveness ratios are used. The average cost effectiveness is calculated as a ratio of the incremental cost of $(C_r - C_b) / (O_r - O_b)$ where C_r is the cost under regulatory option r yielding outcome O_r and, C_b is the cost under the baseline (the comparator option) yielding outcome O_b.

In this case the cost-effectiveness analysis requires the following steps:

1. Define the regulatory options and quantify the expected benefit from each of the options. The type of expected benefit has to be the same across the options;
2. Calculate the incremental cost implied by each regulatory option and subtract any monetized incremental benefit, including cost savings;
3. Calculate the average cost effectiveness of each option as (cost of the option-cost of the baseline)/(quantified benefit of the option-benefits in the baseline);
4. If the amount of the quantified benefit is the same across all the options, choose the option with the lowest average effectiveness ratio as the preferred option; and
5. If the quantified benefits and costs differ among options, eliminate strongly dominated options. An option is strongly dominated when there is another option that provides more benefit for the same or lower cost or the same or higher benefit for a higher cost.

The elimination of strongly dominated options may still leave too many options to choose from. Making a final decision requires extra information from the ultimate decision-maker. For example, within the acceptable options, there may be a preference for the option that provides the most units of effectiveness.

The incremental cost effectiveness ratio (ICER) should be used when the options are mutually exclusive i.e. implementation of one option prevents other options to be implemented or impacts their costs and effectiveness. The incremental cost effectiveness ratio is calculated as the ratio of the differences between the costs and the outcome measures of any two consecutively expensive options. The following steps are required:

1. Rank order the options either by the effectiveness or cost measure;
2. Calculate the incremental effective ratio for consecutive pair of ordered ranked option as (cost for option i –cost for option j)/(effectiveness for option i –effectiveness for option j);
3. Eliminate options that are less effective but have a higher incremental cost effectiveness ratio than the next highest ranked alternative; that is keep options that yield more effectiveness for a lower cost per unit and reject options that results in less effectiveness but have a higher cost per unit of effectiveness; and
4. Recalculate the incremental cost effectiveness ratio for the remaining options and eliminate inefficient options using the weak dominance test as describe in 3 above. Repeat until all weakly dominated options are identified and eliminated.

The process will reduce the options to choose from. However, the decision on the preferred option will depend on the decision maker preferences, as well as other factors such as budget constraints.

7. Step 4: Assessing Uncertainty/Sensitivity Analysis

▶ In this section

Projected benefits and costs so far have been discussed in terms of deterministic values. In practice, future values of benefit and cost items are uncertain. Uncertainty may arise from a lack of scientific knowledge, lack of perfect foresight in forecasting future prices, technological innovation, or consumers and producers' behavioural responses to regulatory actions. For example, there may be uncertainty about the impact of the change

in emissions on the quality of air and likewise the effect of the quality of air on health. The uncertainty is further compounded as the effects would be spread over a long period of time in the future.

7.1 Sensitivity Analysis

Sensitivity analysis [31] allows for the effects of changes in uncertain variables on the outcomes of a regulatory intervention to be factored in the cost-benefit assessment.

One approach to sensitivity analysis involves changing one or more key assumptions or values of key variables while maintaining the others constant at their expected values and studying how this affects the costs and benefits of the regulatory proposal. The results of this approach is often represented using a tornado diagram. Of particular interest are the values of different variables at which the overall net benefit present value switches from positive to negative or vice-versa. A low switching ratio (switch value / expected value) suggests the project is very sensitive to that particular variable.

Scenario analysis is another method used to perform sensitivity analysis. Under this approach, estimates of net benefit present value are carried out assuming the worst and best case scenarios and the results are compared to the expected base case results.

These approaches to sensitivity analysis, however, have their limitations. First, they do not assign probabilities to the different outcomes. Second, the correlations between specific variables might have a very important effect on the evaluation of the outcomes (e.g. annual rainfall and soil erosion). Hence, the usefulness of a scenario analysis is somewhat limited.

Monte Carlo analysis is a natural extension of sensitivity analysis. Monte Carlo analysis [32] is a statistical analytical technique that is based on the statistical distributions underlying the key variables in cost-benefit analysis. Their expected values and variance are used to generate multiples distributions, which in turn result in multiple estimates of the outcome; costs and benefits in this case. The results of the analysis are expressed in terms of the expected costs and benefits and the probabilities of selected key values occurring. This approach to sensitivity analysis yields a more accurate assessment of the likely ranges associated with costs and benefits of a regulatory proposal.

The steps required in undertaking the analysis of a regulatory options are described in Figure 3.

Figure 3. Monte Carlo Simulation

> **Step 1:** Identify risk variables that not only constitute a large share of benefits or costs of the policy or regulation but that are also uncertain in nature.
>
> **Step 2:** Assess how likely the ristk is to occur
>
> **Step 3:** Select the probability distribution (e.g. unifrm, triangular, normal, step, discrete) and the range of values for each risk variable
>
> **Step 4:** Specify the desired number of simulation runs.
>
> **Step 5:** present a series of statistical measures such as the expected present value of net benefits and the variability of the outcomes.

The identified scientific limitations and uncertainties that have a high likelihood of significant impact on the results of the analysis need to be disclosed and reported in a transparent manner. The analysts should include a discussion of the difficulties in trying to resolve the scientific limitations and uncertainties involved, e.g. feasibility, and financial and time constraints on research, etc.

The presence of scientific uncertainty often requires the analyst to make some key assumptions. The basis of these assumptions should be clearly explained. In a case where there are diverse scientific views leading to alternative assumptions, the effects of each alternative assumption on the direction and magnitude of the results need to be discussed. If possible, a quantitative evaluation of the impacts of changes to the alternative assumptions on the estimates should be carried out. The expected results with the assumptions should be compared with the actual empirical results of the study and reported, whether they are in agreement or in conflict with each other. Whenever there is a need to combine several assumptions in the study, the rationale for doing so should also be clearly explained.

Another source of uncertainty is the presence of different models capable of explaining the same phenomenon. Each alternative model may yield different results, therefore the model uncertainty also needs to be well documented and disclosed. Whenever possible, the results should be evaluated for each alternative model separately and then compared with those obtained from the other alternative models. A central measure of the estimate

in this case will be a weighted average of the results obtained from the alternative models. Expert judgment might be needed in estimating the probability weights to be used in the calculation of the expected value.

8. Step 5: Conducting Distributional Analysis

A regulatory initiative can affect various stakeholder groups in very different ways. It is important to provide an analysis of the distribution of the costs and benefits among stakeholder groups to help decision-makers understand the differentiated impacts of the regulation, particularly when some stakeholders are disproportionately affected.

Distributional analysis yields critical information that can help decision-makers take complementary policy measures to alleviate negative impacts on the disproportionately affected stakeholder groups. A disaggregation of stakeholders into sub-groups, such as individuals, consumers, producers, Indigenous groups, ethnic, linguistic, age, income groups and gender, provides useful insight into the distributional impact of the regulation. This is not an exhaustive list, and regulators may use sub-groups that are relevant to the proposed regulatory initiative including regional distributional of impacts.

When it is not possible to assign the costs or benefits to an identifiable group or sub-group of stakeholders, such as when a regulation's benefit is climate change mitigation, meaningful groupings such as distribution of impacts by regions, provinces/territories, sector or any other groupings that the department or agency deems relevant may provide useful information.

When the regulation significantly impacts Indigenous groups, gender-based analysis plus groups and small business, the distributional analysis should provide a breakout of costs and benefits in the CBA and the Regulatory Impact Analysis Statement (for more on RIAS, see section 9.2 below).

9. Cost-Benefit Analysis: Transparency Requirements

▶ In this section

9.1 Consultations and engagement with stakeholders, interested groups and experts

Departments and agencies are expected to consult with stakeholders to support development of the CBA. The engagement with stakeholders will ensure that:

- relevant costs and benefits have been identified;
- assumptions have been validated;
- perspectives on the definition of the baselines have been shared; and
- critical technical information to properly model the costs and benefits of the regulatory scenario(s) have been obtained.

9.2 Preparing a CBA Summary for the Regulatory Impact Analysis Statement (RIAS)

To ensure accountability and transparency, departments and agencies should always provide a thorough summary of the CBA in the RIAS [33]. The summary should include basic information such as the present value base year, the price year, the discount rate, explanation of approaches used to estimate the costs and benefits, the limitations of the analysis, the period of analysis, distributional analysis and sensitivity analysis results. Departments and agencies should always provide a rigorous qualitative analysis of the costs and benefits of the regulatory proposal that have not been monetized or quantified.

In addition to completing the CBA summary in the RIAS, a CBA summary statement is required for quantified and monetized impacts.

Section A: Quantified and monetized impacts

Departments and agencies should present estimates of the total present value and the annualized value for each of the benefits and costs estimated by stakeholders. Dollar estimates should be expressed in constant dollar terms, with the units (thousands, millions, billions) and constant dollar base year clearly indicated.

The Total Present Value (PV) should be included for monetized costs and benefits, and the discount rate applied should be indicated in the table.

The Net Benefit or Cost (i.e. the benefits less the costs) should be provided in order to obtain the net present value of the regulatory proposal under analysis. Only those benefits and costs that are monetized and have standing can be aggregated to arrive at net benefits.

Section B: Quantified impacts that cannot be monetized

Where some or all benefits or costs of a regulatory proposal cannot be monetized, but can be quantified, they should be listed with physical units by stakeholders. Departments and agencies should include both positive and negative impacts that have been quantified and indicate clearly the unit of measure.

Cost-benefit statement (mandatory for significant-cost-impact proposals)

Number of years: # (*also state years, e.g.,* 2020 to 2029)
Base year for costing [34]: 20##
Present value base year [35]: 20##
Discount rate: #%

Monetized costs

Impacted stakeholder	Description of cost	Base year	Other relevant years	Final year	Total (present value)	Annualized value
Government	e.g., Administration	$	$	$	$	$
Industry	e.g., Phase out of existing stock	$	$	$	$	$
Industry	e.g., New equipment	$	$	$	$	$
Canadians	e.g., Higher price for product	$	$	$	$	$
All stakeholders	**Total costs**	**$**	**$**	**$**	**$**	**$**

Monetized benefits

Impacted stakeholder	Description of benefit	Base year	Other relevant years	Final year	Total (present value)	Annualized value
Government	e.g., Reduced health care costs	$	$	$	$	$
Industry	e.g., Efficiency	$	$	$	$	$
Canadians	e.g., Air quality	$	$	$	$	$
All stakeholders	**Total benefits**	**$**	**$**	**$**	**$**	**$**

Summary of monetized costs and benefits

Impacts	Base year	Other relevant years	Final year	Total (present value)	Annualized value
Total costs	$	$	$	$	$
Total benefits	$	$	$	$	$
NET IMPACT	**$**	**$**	**$**	**$**	**$**

Quantified (non-$) and qualitative impacts (if required)

Positive impacts *(if required)*

- Positive impact and impacted stakeholder (e.g., 145 fewer fatalities annually in Canada)
- Positive impact and impacted stakeholder

Negative impacts *(if required)*

- Negative impact and impacted stakeholder (e.g., 5 businesses to lose accreditation annually)
- Negative impact and impacted stakeholder

9.3 Preparing a CBA report

A stand-alone CBA report should be developed by the department or agency to provide a complete account of how the CBA was conducted, including any additional detail that would typically not be included in the RIAS (i.e., methodological approaches). The CBA report should be structured along the outline in Figure 5. The full CBA report could be made available on the regulatory organization's website, or, at a minimum, available to any interested parties upon request.

The CBA report should be sufficiently detailed for readers to understand how the CBA results were generated. This would include formulas used, and data sources and assumptions made need to be documented in the CBA report. As well, departments and agencies must make the data used in the CBA report available upon request. Privacy, risks of lowering stakeholders surveys response rate, intellectual property and trade secrets concerns may prevent full disclosure of the data or models. In these cases, justification must be provided in the CBA report.

Figure 4. Outline of a Cost-Benefit Analysis Report

Title page

- Title of the regulatory proposal
- Author of the cost-benefit analysis
- Name of department
- Contact information for the people involved in the cost-benefit analysis

Executive summary

- Abstract
- Benefits and costs
- Cost-benefit statement
- Impacts to businesses and consumers
- Distributional impacts

Background

- Context of the regulation
- Description of the issue the proposed regulation addresses
- The regulatory proposal: overview of objectives and regulatory scenario
- The baseline scenario: description of what would happen in the absence of the regulation

Options considered

- Description of regulatory options considered

Stakeholders: profile, identification of costs and benefits, and description

- Profile of affected stakeholders
- Costs of the regulatory proposal: identification and description
- Benefits of the regulatory proposal: identification and description

Methodology: cost and benefit valuation

- Review of literature in order to value the identified costs and benefits
- Models and assumptions made in order to value the identified costs and benefits
- Approaches to sensitivity analysis
- Data description, limitations and sources

Results

- Costs estimates
- Benefits estimates
- Sensitivity analysis
- Distributional analysis

Conclusions

Appendices and references

- Data tables
- References

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Date modified: 2022-03-29