6 Identifying impacts: how pricing policies reduce GHG emissions

This chapter provides a process for identifying the most common GHG impacts of transport pricing policies, and guidance for users to identify any additional impacts their policies may have. A list of impacts is provided, as well as a causal chain indicating which impacts are included in the GHG assessment boundary. Guidance is also provided on defining the assessment period. The steps in this chapter are closely interrelated. Users can carry out the steps in sequence or in parallel, and the process may be iterative.

Checklist of key recommendations

- Identify all potential GHG impacts of the policy and associated GHG source categories
- Develop a causal chain
- Include all significant GHG impacts in the GHG assessment boundary
- Define the assessment period

6.1 Identify GHG impacts

GHG impacts are the changes in GHG emissions that result from the policy. For most transport pricing policies being assessed using this methodology, the relevant GHG impacts are likely to be reduced emissions from reduced vehicle travel, shifts to other transport modes and shifts to more fuel-efficient vehicles. Guidance is also provided for identifying GHG impacts of policies where significant impacts arise from the use of revenues.

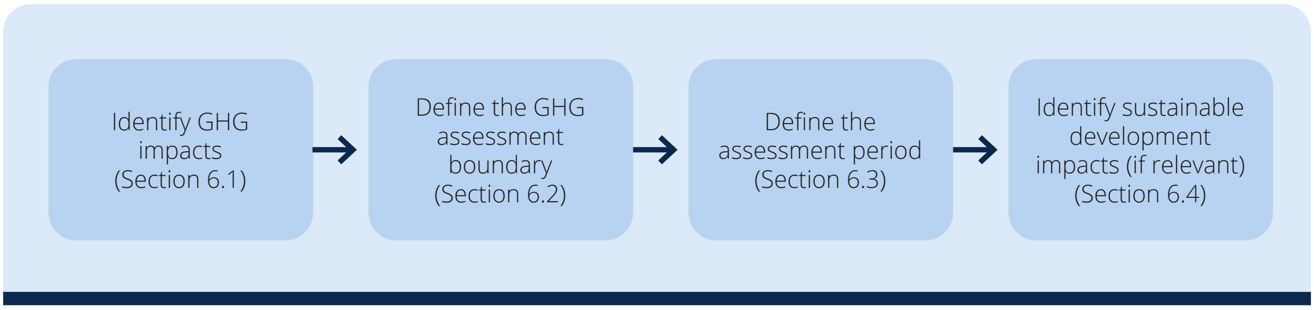
6.1.1 Identify intermediate effects

To identify the GHG impacts of a policy, it is useful to first consider how the policy is implemented by identifying the relevant inputs and activities associated with implementing the policy. Inputs are resources that go into implementing the policy, and activities are administrative activities involved in implementing the policy. These inputs and activities lead to intermediate effects, which are changes in behaviour, technology, processes or practices that result from a policy. Intermediate effects can be categorized by how stakeholders are expected to respond to the policy or to other intermediate effects of the policy, or by the mitigation action or change in behaviour that is mandated or incentivized by the policy. These intermediate effects then lead to the policy's GHG impacts (the reduction in emissions).

Users should identify all intermediate effects that may lead to GHG impacts. The key intermediate effects of an increase in fuel costs are reduced vehicle travel, a shift to other transport modes, and a shift to more fuel-efficient vehicles. The reduction in vehicle travel occurs through two main channels: (1) a reduction in overall vehicle trips, and (2) a modal shift, which contributes to both a reduction in overall vehicle trips and a shift to more efficient transport

FIGURE **6.1**

Overview of steps in the chapter



alternatives. The degree of modal shift depends on the quality of the available substitutes and other factors, including social standing and safety.

The intermediate effects of fuel pricing policies include:

- increased fuel prices
- greater increases in fuel prices for more carbon-intensive fuels, such as gasoline
- reduced vehicle travel
- increased switching to more fuel-efficient and alternative-fuel vehicles
- increased purchase of more fuel-efficient and alternative-fuel vehicles.

6.1.2 Identify potential GHG impacts

It is a *key recommendation* to identify all potential GHG impacts of the policy and associated GHG source categories. Guidance for this is provided below, and further discussion on the process is available in the *Policy and Action Standard*.

The key GHG impacts are the reductions in GHG emissions directly resulting from the identified intermediate effects. Other emission impacts depend on how pricing revenue is used, as discussed below.

Stakeholder consultation can help to ensure the completeness of the list of GHG impacts. Refer to the ICAT *Stakeholder Participation Guide* (Chapter 8) for information on designing and conducting consultations. Relevant stakeholders may include departments or ministries of transport, ministries of finance, national governments, city governments, transportation associations, public transit authorities, energy planning offices, taxation bureaus, the construction industry, the trucking industry, fleet operators, vehicle manufacturers, and consumers.

Users should identify all the GHG source categories associated with the GHG impacts of the policy. Example source categories are provided in Table 6.1.

Importance of how revenues from pricing policies are used

Impacts relating to the use of available revenue generated from the policy cannot be quantified using the calculations in this methodology. However, it is crucial to bear in mind that the use of revenue has a significant influence on GHG impacts (see Appendix D). Users should account for the impacts of the use of revenues by assessing them at least qualitatively and discussing them in the interpretation of their assessment results, as described in Section 8.3.

Increased revenues may be used for different purposes, including:

- use in government spending, which may lead to higher emissions if spent on roadways, for example, rather than infrastructure for public transport, bicycle lanes, and so on

TABLE **6.1**

Example GHG sources for fuel pricing policies

Source category	Description	Emitting entity or equipment	Relevant GHGs
Road transport, LDVs	Fuel combustion from LDVs	Passenger vehicles, light-duty trucks, motorcycles	CO_2
Road transport, HDVs	Fuel combustion from HDVs	Heavy-duty trucks and buses	CO_2
Rail transport	Fuel combustion and electricity use from locomotives	Diesel and electric locomotives	CO_2

Source: Adapted from WRI (2015).

Abbreviations: HDV, heavy-duty vehicle; LDV, light-duty vehicle

- revenue-neutral redistribution to households through
  - lowered taxes, possibly increasing consumer spending and in turn increasing emissions from households
  - targeted subsidies to poor populations to provide a social cushion for subsidy removal
  - equal per capita redistribution
- transport infrastructure, which tends to increase emissions if invested in roadways rather than public transport, bicycle lanes, and so on
- transport efficiency increases (e.g. promoting public transport), which tends to decrease emissions.

For example, several cities primarily use revenue to expand public transport and non-motorized transport facilities. This may reinforce emissions reductions, given that public transport emissions are likely to be relatively small. Many road pricing policies, in contrast, use the revenue to expand roadway capacity, which tends to increase emissions.

Thus, the use of revenues may either further decrease or increase GHG emissions. Revenues may be used to cushion the social burden of removing fuel subsidies – for example, by introducing targeted (e.g. per capita) subsidies for the fraction of the population most impacted by fuel subsidy removal.

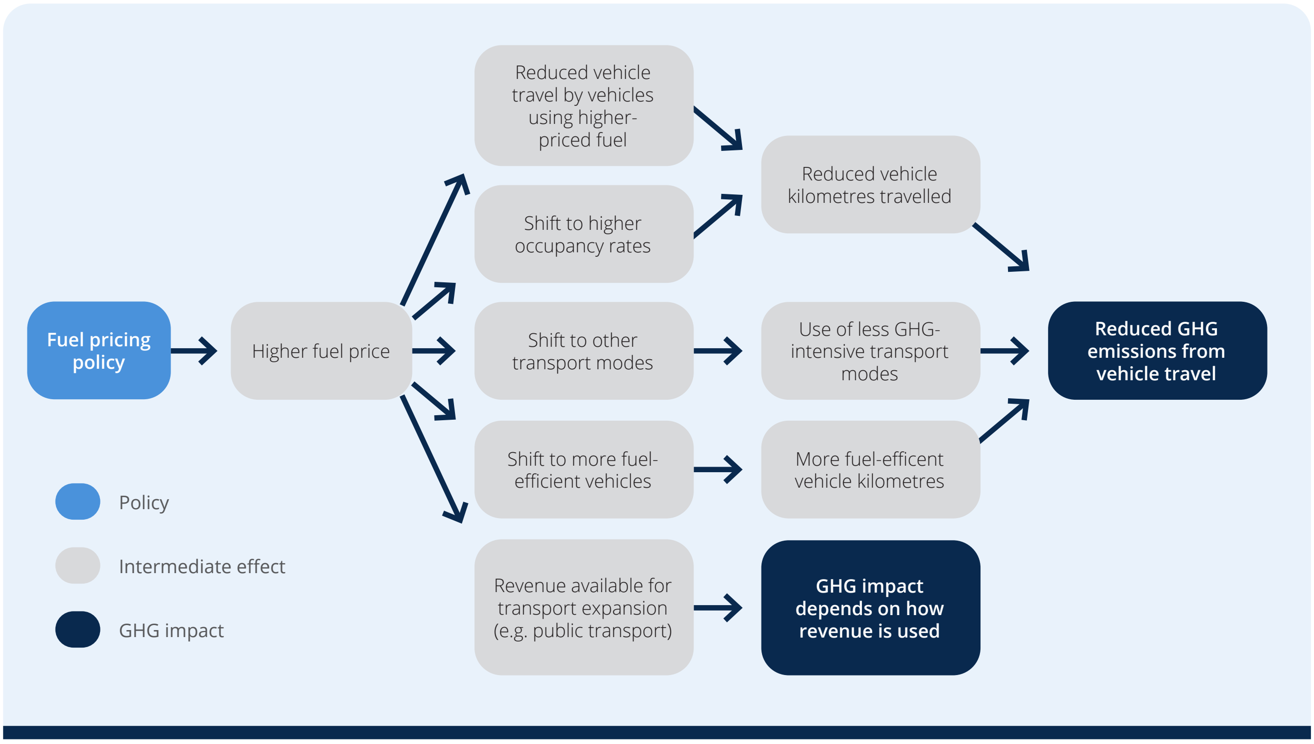
6.1.3 Develop a causal chain

It is a *key recommendation* to develop a causal chain. A causal chain is a conceptual diagram tracing the process by which the policy leads to GHG impacts through a series of interlinked logical and sequential stages of cause-and-effect relationships. Developing a causal chain can help identify effects not previously identified. Figure 6.2 shows a high-level, illustrative example of a causal chain. Causal chains will vary from policy to policy, as will the strength of the links in the causal chain. Users should create their own causal chains, most likely with more (and different) detail from that shown in Figure 6.2.

Consultations with different stakeholder groups affected by, or with influence over, the policy can help with development and validation of the causal chain by integrating stakeholder insights on cause-

FIGURE **6.2**

Example causal chain for fuel pricing policies



and-effect relationships between behaviour changes and expected impacts. Refer to the ICAT *Stakeholder Participation Guide* for information on identifying and understanding stakeholders (Chapter 5), and designing and conducting consultations (Chapter 8).

Where users are also applying the ICAT *Sustainable Development Methodology*, the causal chain can be used as a starting point for a causal chain mapping exercise that includes sustainable development impacts as well as GHG impacts.

6.2 Define the GHG assessment boundary

The GHG assessment boundary defines the scope of the assessment in terms of the range of GHG impacts. It is a *key recommendation* to include all significant GHG impacts in the GHG assessment boundary. The identified GHG impacts and the associated GHG source categories should be categorized for magnitude and likelihood. They should be included in the GHG assessment boundary if they are categorized as moderate or major in magnitude, and very likely, likely or possible in likelihood (i.e. deemed significant). The *Policy and Action Standard* provides further information about categorizing GHG impacts.

For pricing policies, the relevant GHG impacts are reduced GHG emissions from vehicle travel, caused by reduced vehicle kilometres travelled, a shift to less GHG-intensive transport modes, and a shift to more fuel-efficient vehicles. These GHG impacts are included in the assessment boundary because they are categorized as either likely or very likely, and of moderate or major relative magnitude.

Users should note that GHG emissions resulting from the use of revenue may indeed be significant and are therefore included in the GHG assessment boundary. However, these GHG impacts have not been included in the GHG assessment boundary of the methodology. Emissions may increase or decrease depending on how revenue is used (see Section 6.1.2), and users should ensure that they account for these impacts.

Table 6.2 lists GHG impacts and source categories of fuel pricing policies. Users should check the list to ensure that each of the GHG impacts is categorized appropriately for their policy. Any GHG impacts that are categorized as moderate or major in magnitude

TABLE **6.2**

Example GHG impacts and source categories included/excluded in the GHG assessment boundary

GHG impact	GHG	Likelihood	Relative magnitude	Included or excluded	Explanation
Reduced GHG emissions from reduced VKT in road transport (LDV/HDV)	CO_2	Likely	Major	Included	It is likely that car drivers will react to higher fuel prices, which will lead to reduced vehicle travel. Since CO_2 is the major emissions source in the transport sector, this will have a major impact.
Reduced GHG emissions from reduced VKT in road transport (LDV/HDV)	CH_4	Likely	Minor	Excluded	CO_2 emissions are the most significant GHG source. However, if the policy increases the use of CNG, CH_4 leakage may be significant and should be included.
Reduced GHG emissions from use of less GHG-intensive modes	CO_2	Likely	Major	Included	Depends on policy implementation, and the quality and availability of substitutes, as well as consumer behaviour; considered significant for most fuel pricing policies

TABLE **6.2,** continued

Example GHG impacts and source categories included/excluded in the GHG assessment boundary

GHG impact	GHG	Likelihood	Relative magnitude	Included or excluded	Explanation
Reduced GHG emissions from more efficient VKT	CO_2	Likely	Major	Included	Depends on quality and availability of substitutes, their ability to compete in the market, and consumer behaviour (e.g. mode shift or carpooling); considered significant for most fuel pricing policies
GHG emissions increase, where the revenue is spent on roadways	CO_2	Possible	Major	Excluded for the purposes of the methodology; should be accounted for, where relevant	Depends on how revenues are used; may be significant
GHG emissions reductions increase, where the revenue is spent on public transport infrastructure	CO_2	Possible	Major	Excluded for the purposes of the methodology; should be accounted for, where relevant	Depends on how revenues are used; may be significant

Source: Adapted from WRI (2015).

Abbreviations: CH_4, methane; CNG, compressed natural gas; CO_2, carbon dioxide; HDV, heavy-duty vehicle; LDV, light-duty vehicle; VKT, vehicle kilometres travelled

and very likely, likely or possible in likelihood should be included in the GHG assessment boundary.

6.3 Define the assessment period

The GHG assessment period is the time period over which GHG impacts resulting from the policy are assessed; it is based on the time horizon of the GHG impacts included in the GHG assessment boundary. It is a *key recommendation* to define the assessment period.

Where possible, users should align the GHG assessment period with other assessments being conducted using ICAT methodologies. For example, where users are assessing the pricing policy's sustainable development impacts using the ICAT *Sustainable Development Methodology* in addition to assessing GHG impacts, the assessment period should be the same.

The ex-ante GHG assessment period is usually determined by the longest-term impact included in the GHG assessment boundary. The GHG assessment period can be longer than the implementation period, and should be as long as necessary to capture the full range of significant impacts, based on when they are expected to occur.

For an ex-post assessment, the assessment period can be the period between the date the policy is implemented and the date of the assessment, or it can be a shorter period between these two dates. The assessment period for a combined ex-ante and ex-post assessment should consist of both an ex-ante assessment period and an ex-post assessment period.

Users should consider the assessment objectives and stakeholders' needs when determining the assessment period. Where the objective is to understand the expected contribution of the policy towards achieving a country's NDC, it may be most appropriate to align the assessment period with the NDC implementation period (e.g. ending in 2030). To align with the Paris Agreement modalities, procedures and guidelines, projections should begin from the most recent year of data and extend at least 15 years beyond the next year ending in zero or five. To align with longer-term trends and planning, users should select an end date such as 2040 or 2050. In addition, users can separately estimate and report impacts over any other time periods that are relevant. For example, if the implementation period is 2020–2040, a user can separately estimate and report impacts over the periods 2020–2030, 2030–2040 and 2020–2040.

6.4 Identify sustainable development impacts (if relevant)

Pricing policies have other sustainable development impacts in addition to their GHG impacts. Sustainable development impacts are changes in environmental, social or economic conditions that result from a policy, such as changes in economic activity, employment, public health, air quality and energy security.

Table 6.3 shows examples of sustainable development impacts associated with pricing policies. Refer to the ICAT *Sustainable Development Methodology* for the method for conducting a full assessment of sustainable development impacts of a policy.

TABLE **6.3**

Examples of sustainable development impacts and indicators relevant to transport pricing policies

Impact categories	Indicators
Environmental impacts	
Air quality and health impacts of air pollution (SDGs 3, 11, 12)	• Emissions of air pollutants such as particulate matter ($PM_{2.5}$, PM_{10}), ammonia, ground-level ozone (resulting from VOCs and NO_x), carbon monoxide, sulfur dioxide, nitrogen dioxide, fly ash, dust, lead, mercury, and other toxic pollutants (t/year) • Concentration of air pollutants (mg/m^3) • Concentration of aerosol particles (mg/m^3) • Indoor and outdoor air quality • Morbidity (DALYs, QALYs and ADALYs) • Mortality (avoided premature deaths per year)
Energy (SDG 7)	• Energy consumption • Energy efficiency • Energy generated by source • Renewable energy generation • Renewable energy share of total final energy consumption • Primary energy intensity of the economy (e.g. tonnes of oil equivalent/GDP)
Depletion of non-renewable resources	• Consumption of mineral resources • Consumption of fossil fuels • Scarcity of resources
Social impacts	
Illness and death (SDG 3)	• Life expectancy (years) • Avoided premature deaths per year • Morbidity (DALYs, QALYs and ADALYs) • Prevalence of, or reduction in, respiratory illnesses

TABLE **6.3,** continued

Examples of sustainable development impacts and indicators relevant to transport pricing policies

Impact categories	Indicators
Social impacts, continued	
Mobility (SDG 11)	• Number of people or proportion of population with convenient access to employment, schools, health care or recreation, by sex, age and persons with disabilities
Traffic congestion	• Time lost during transportation • Economic cost of time lost
Road safety (SDGs 3, 11)	• Number of deaths and injuries from road traffic accidents per year
Economic impacts	
Costs and cost savings	• Fuel costs or cost savings • Health-care costs or cost savings • Economic costs of human health losses from air pollution based on social welfare indicator (ADALYs monetized in terms of social welfare valuation based on willingness to pay VSL estimates) or national accounts indicator (ADALYs monetized based on foregone output estimates based on productivity/wage approaches)
Government budget surplus/deficit	• Annual revenue • Annual expenditures • Annual surplus or deficit

Source: Adapted from ICAT *Sustainable Development Methodology*.

Abbreviations: ADALY, averted disability-adjusted life year; DALY, disability-adjusted life year; GDP, gross domestic product; NO_x, nitrogen oxides; QALY, quality-adjusted life year; SDG, Sustainable Development Goal; VOC, volatile organic compound; VSL, value of a statistical life