

Greenhouse Gas Protocol

Policy and Action Standard

Exercises

Exercise 1: Identifying effects

The list below provides some potential effects (not an exhaustive list) for a renewables obligation policy, that currently being planned and is expected to begin implementation in 2023:

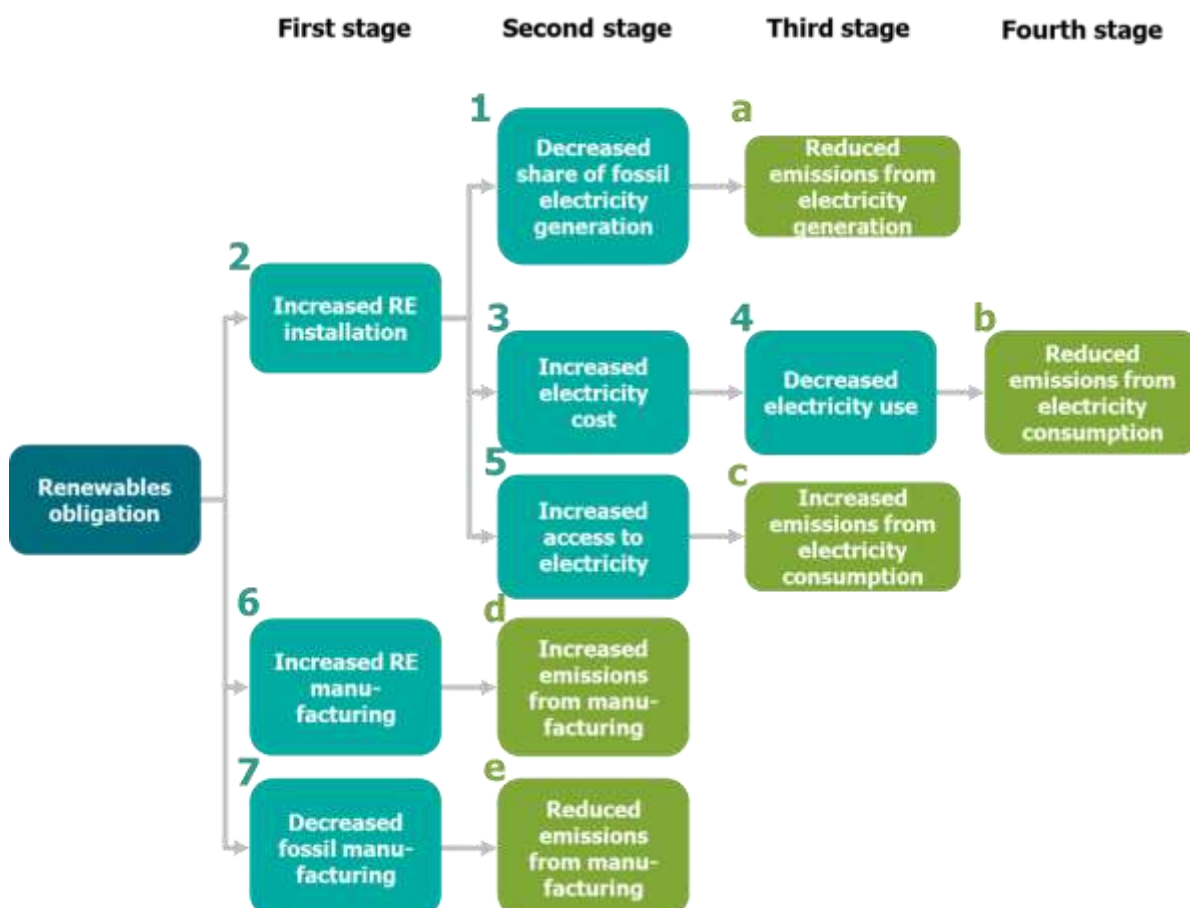
- I. Decreased emissions from imported fossil fuel generation equipment
- II. Reduced GHG emissions from operating fossil fuel fired plants in the grid
- III. Increased emissions from imported renewable generation equipment
- IV. Reduced emissions from reduced electricity consumption due to higher prices
- V. Increased emissions from national production of renewable generation equipment
- VI. Reduced emissions from national manufacturing fossil fuel fired plant equipment
- VII. Increased emissions from higher energy use due to improved access

Differentiate the effects by type and put them in the table below.

| Indicator types | Short-term | Long-term |
|---|--|---|
| Intended effects | <p>(II.) Reduced GHG emissions from operating fossil fuel fired plants in the grid</p> <p>(VI.) Reduced emissions from national manufacturing of fossil fuel fired plant equipment</p> | |
| Unintended effects (Including rebound effects) | <p>(V.) Increased emissions from national production of renewable generation equipment</p> <p>(IV.) Reduced emissions from reduced electricity consumption due to higher prices</p> | (VII.) Increased emissions from higher energy use due to improved access |
| Out-of-jurisdiction effects (Leakage and spillover effects) | <p>(III.) Increased emissions from imported renewable generation equipment</p> <p>(I.) Decreased emissions from imported fossil fuel generation equipment</p> | |

Exercise 2: Mapping the causal chain

Complete the causal chain below based on the in-jurisdiction effects identified in exercise 1, by matching the effects to their location on the causal chain map.



| Intermediate effect | Map location |
|--|--------------|
| Increased access to electricity | 5 |
| Decreased electricity use | 4 |
| Decreased fossil manufacturing | 7 |
| Decreased share of fossil electricity generation | 1 |
| Increased RE manufacturing | 6 |
| Increased RE installation | 2 |
| Increased electricity cost | 3 |

| GHG effect | Map location |
|--|--------------|
| Increased emissions from manufacturing | d |
| Increased emissions from electricity consumption | c |
| Reduced emissions from electricity generation | a |
| Reduced emissions from manufacturing | e |
| Reduced emissions from electricity consumption | b |

Intermediate effects (arranged in serial order)

| |
|---|
| 1. Decreased share of fossil electricity generation |
| 2. Increased RE installation |
| 3. Increased electricity cost |
| 4. Decreased electricity use |
| 5. Increased access to electricity |
| 6. Increased RE manufacturing |
| 7. Decreased fossil manufacturing |

GHG effects (arranged in serial order)

| |
|--|
| a. Reduced emissions from electricity generation [listed as II. in Exercise 1] |
| b. Reduced emissions from electricity consumption [listed as IV. in Exercise 1] |
| c. Increased emissions from electricity consumption [listed as VII. in Exercise 1] |
| d. Increased emissions from manufacturing [listed as V. in Exercise 1] |
| e. Reduced emissions from manufacturing [listed as VI. in Exercise 1] |

Exercise 3: Assessing effects by gas

Which of the effects and gases should be included in the GHG assessment boundary given the assessment of likelihood and magnitude in the table below?

| GHG effect | Likelihood | Relative magnitude | Included? |
|---|------------|--------------------|-----------------|
| Reduced emissions from operating fossil fuel fired plants in the grid | | | |
| CO₂ | Likely | Major | Included |
| CH₄ | Likely | Minor | Excluded |
| N₂O | Likely | Minor | Excluded |
| Reduced emissions from national manufacturing of fossil fuel fired plant equipment | | | |
| CO₂ | Unlikely | Moderate | Excluded |
| CH₄ | Unlikely | Minor | Excluded |
| N₂O | Unlikely | Minor | Excluded |
| Increased emissions from national production of renewable generation equipment | | | |

| | | | |
|--|----------|----------|-----------------|
| CO₂ | Possible | Minor | Excluded |
| CH₄ | Possible | Minor | Excluded |
| N₂O | Possible | Minor | Excluded |
| Reduced emissions from reduced electricity consumption due to higher prices | | | |
| CO₂ | Possible | Moderate | Included |
| CH₄ | Possible | Minor | Excluded |
| N₂O | Possible | Minor | Excluded |

| Likelihood | Magnitude | | |
|---------------|-------------|----------------|-------|
| | Minor | Moderate | Major |
| Very likely | May exclude | Should include | |
| Likely | | | |
| Possible | | | |
| Unlikely | | | |
| Very unlikely | | | |

Note: The area shaded green corresponds to significant GHG effects.

Exercise 4: Calculate baseline emissions

Equation:

$$\begin{aligned} \text{Baseline emissions} &= \sum(\text{Electricity demand} * \text{share in fuel mix}_{\text{fuel}} * \text{emission factor}_{\text{fuel}}) \\ &= \text{Electricity demand} * \text{share in fuel mix}_{\text{gas}} * \text{emission factor}_{\text{gas}} \\ &+ \text{Electricity demand} * \text{share in fuel mix}_{\text{REN}} * \text{emission factor}_{\text{REN}} \end{aligned}$$

| Parameters | Values 2022 |
|--------------------|---|
| Electricity demand | 100 TWh/yr |
| Share in fuel mix | Share _{gas} : 95% Gas |
| | Share _{REN} : 5% Renewables |
| Emission factors | Emission factor _{gas} : 200,000 t CO ₂ /TWh |
| | Emission factor _{REN} : 0 t CO ₂ /TWh |

Emissions factor rounded to facilitate calculation

$$\begin{aligned} \text{Baseline emissions} &= 100 \text{ TWh/yr} * 0.95 * 200,000 \text{ t CO}_2/\text{TWh} + 100 \text{ TWh/yr} * 0.05 * 0 \text{ t CO}_2/\text{TWh} \\ &= 19,000,000 \text{ t CO}_2/\text{yr} + 0 \text{ t CO}_2/\text{yr} \\ &= 19.0 \text{ Mt CO}_2/\text{yr} \end{aligned}$$

Exercise 5: Estimate policy scenario emissions

Equation:

$$\begin{aligned} \text{Policy scenario emissions} &= \sum(\text{Electricity demand} * \text{share in fuel mix}_{\text{fuel}} * \text{emission factor}_{\text{fuel}}) \\ &= \text{Electricity demand} * \text{share in fuel mix}_{\text{gas}} * \text{emission factor}_{\text{gas}} \\ &+ \text{Electricity demand} * \text{share in fuel mix}_{\text{REN}} * \text{emission factor}_{\text{REN}} \end{aligned}$$

| Parameters | Values 2025 |
|--------------------|---------------------------------------|
| Electricity demand | 100 TWh/yr |
| Share in fuel mix | Share _{gas} : 80% Gas |
| | Share _{REN} : 20% Renewables |

| | | |
|------------------|----------------------------------|--------------------------------|
| Emission factors | Emission factor _{gas} : | 200,000 t CO ₂ /TWh |
| | Emission factor _{REN} : | 0 t CO ₂ /TWh |

Emissions factor rounded to facilitate calculation

$$\text{Policy scenario emissions} = 100 \text{ TWh/yr} * 0.80 * 200,000 \text{ t CO}_2/\text{TWh} + 100 \text{ TWh/yr} * 0.20 * 0 \text{ t CO}_2/\text{TWh}$$

$$= 16,000,000 \text{ t CO}_2/\text{yr} + 0 \text{ t CO}_2/\text{yr}$$

$$= 16.0 \text{ Mt CO}_2/\text{yr}$$

Exercise 6: Calculating GHG effects ex-ante

Calculate the change in GHG emissions based on the information provided in the table below.

| Effect | Estimated baseline emissions in 2022 | Estimated policy emissions in 2025 | Change (Policy - Baseline) |
|--|--------------------------------------|------------------------------------|-------------------------------|
| Reduced emissions from stationary combustion for electricity production | 19.0 Mt CO ₂ | 16.0 Mt CO ₂ | -3 Mt CO₂ |
| Reduced emissions from decreased energy consumption due to higher prices | / | -0.4 Mt CO ₂ | -0.4 Mt CO₂ |
| Total | 19.0 Mt CO₂ | 15.6 Mt CO₂ | -3.4 Mt CO₂ |

Exercise 7: Complete table 5 from Annex II, decision 5/CMA.3 (common tabular format adopted in Glasgow)

Complete an entry into the table, based on the example policy we have utilized throughout these exercises (renewables obligation).

5. Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement^{a,b}

| Name ^c | Description ^{d,e,f} | Objectives | Type of instrument ^g | Status ^h | Sector(s) affected ⁱ | Gases affected | Start year of implementation | Implementing entity or entities | Estimates of GHG emission reductions (kt CO ₂ eq) ^{j,k} | |
|-------------------|------------------------------|------------|---------------------------------|---------------------|---------------------------------|----------------|------------------------------|---------------------------------|---|----------|
| | | | | | | | | | Achieved | Expected |

^a Each Party shall provide information on actions, policies and measures that support the implementation and achievement of its NDC under Article 4 of the Paris Agreement, focusing on

| 5. Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement | | | | | | | | | | |
|---|---|---|--------------------|---------|--------------------|-----------------|------------------------------|---------------------------------|--|--|
| Name | Description | Objectives | Type of instrument | Status | Sector(s) affected | Gases affected | Start year of implementation | Implementing entity or entities | Estimates of GHG emission reductions (kt CO ₂ eq) | |
| | | | | | | | | | Achieved | Expected |
| Renewables obligation | Mandate to reduce percentage of fossil fuel fired energy generation | Reduced GHG emissions from operating fossil fuel fired plants in the grid | Regulation | Planned | Energy | CO ₂ | 2023 | National utility | | 3.4 Mt CO ₂ e = 3400 kt CO ₂ e |