

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:

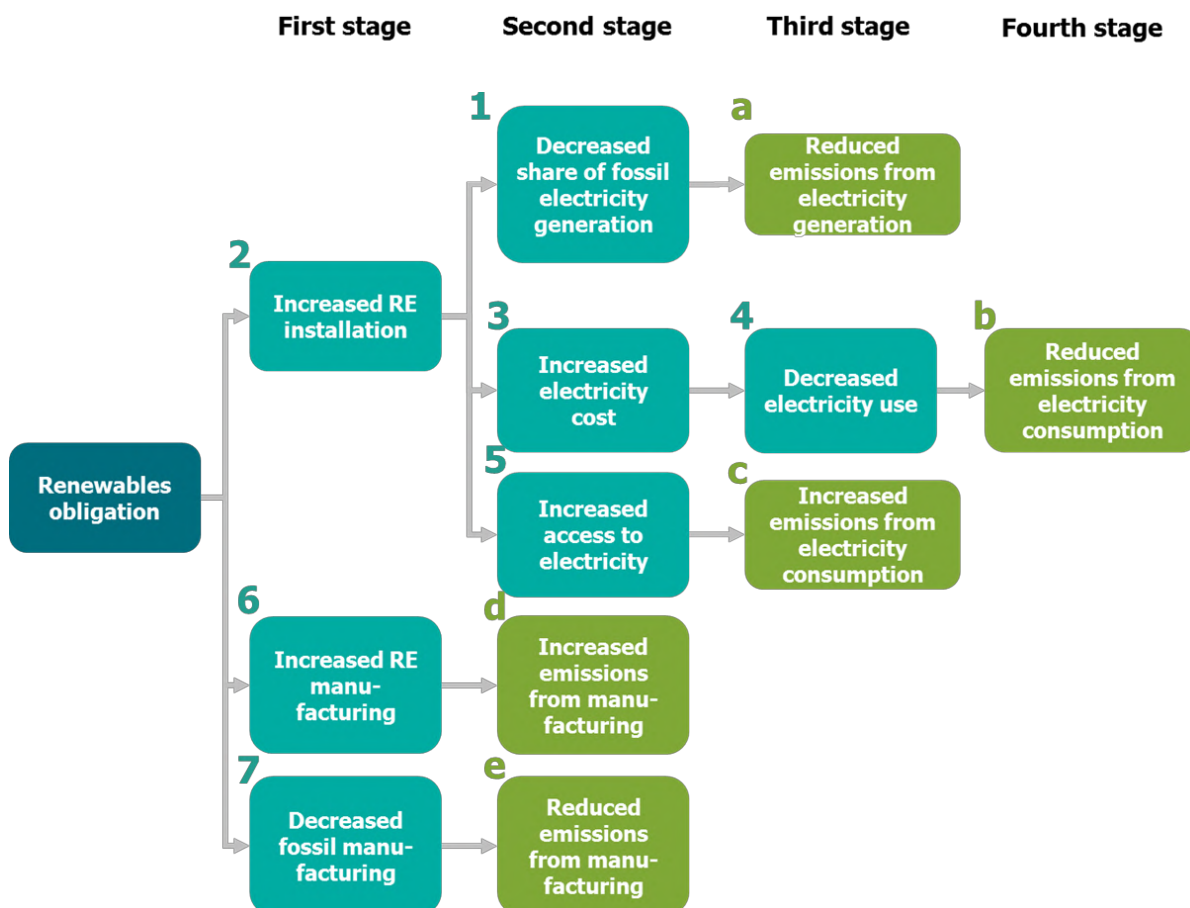
- I. Decreased emissions from imported fossil fuel generation equipment
- II. Reduced GHG emissions from operating fossil fuel fired plants in the grid
- III. Increased emissions from imported renewable generation equipment
- IV. Reduced emissions from reduced electricity consumption due to higher prices
- 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>	<p>(VII.) Increased emissions from higher energy use due to improved access</p>
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			
CO ₂	Likely	Major	Included
CH ₄	Likely	Minor	Excluded
N ₂ O	Likely	Minor	Excluded
Reduced emissions from national manufacturing of fossil fuel fired plant equipment			
CO ₂	Unlikely	Moderate	Excluded
CH ₄	Unlikely	Minor	Excluded
N ₂ O	Unlikely	Minor	Excluded
Increased emissions from national production of renewable generation equipment			
CO ₂	Possible	Minor	Excluded
CH ₄	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

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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