

## MODULE 3

### WORKSHEET 1: CO<sub>2</sub> AND NO<sub>x</sub> EMISSION ANALYSIS IN THE HYDROGEN SUPPLY CHAIN

#### Substantive Introduction

**Hydrogen transportation**, while inherently clean, is associated with pollutant emissions from logistics processes—especially road transport. In the context of the European Green Deal and the pursuit of climate neutrality, analyzing and reducing CO<sub>2</sub> (greenhouse gas) and NO<sub>x</sub> (nitrogen oxides, which impact air quality and human health) emissions is becoming crucial in designing sustainable H<sub>2</sub> supply chains.

Simplified emission estimates for various modes of transport per 100 km of transport of a load of 24 tonnes of hydrogen are presented below.

Means of Transport	Form of Hydrogen	CO <sub>2</sub> Emissions (kg/100 km)	NO <sub>x</sub> Emissions (g/100 km)
Euro VI Truck (diesel)	CGH <sub>2</sub>	120	600
Electric Rail (EU mix)	CGH <sub>2</sub>	40	80
Pipeline (energy from EU mix)	CGH <sub>2</sub>	20	10
Cryogenic Truck (LH <sub>2</sub> )	LH <sub>2</sub>	150	800

**TASK 1:**

Calculate Emissions in Scenarios A and B

**Scenario A:** Transport of CGH<sub>2</sub> by Euro VI truck over a distance of 300 km.

$$\text{CO}_2 = 120 \text{ kg} \times 3 = 360 \text{ kg} \quad \text{NO}_x = 600 \text{ g} \times 3 = 1800 \text{ g}$$

**Scenario B:** Transporting CGH<sub>2</sub> by rail over the same distance.

$$\text{CO}_2 = 40 \text{ kg} \times 3 = 120 \text{ kg} \quad \text{NO}_x = 80 \text{ g} \times 3 = 240 \text{ g}$$

Record the results and compare.

**Task 2****TASK 2:**

Choose the Best Option and Justify

**Consider not only emissions, but also:**

- availability of infrastructure,
- implementation costs,
- security,
- planned range and frequency of transport.

Write a short justification (3–5 sentences).

**Single Choice (5 questions):**

**Question 1: Which means of transport produces the lowest CO<sub>2</sub> emissions per 100 km?**

- A) Dormitory
- B) Pipeline
- C) LH<sub>2</sub> Truck
- D) Euro VI truck

**Question 2: Which means of transport generates the highest NO<sub>x</sub> emissions?**

- A) Pipeline
- B) Railway
- C) LH<sub>2</sub> Truck
- D) Euro VI truck

**Question 3: The CO<sub>2</sub> emissions for an LH<sub>2</sub> truck per 500 km are:**

- A) 450 kg
- B) 150 kg
- C) 600 kg
- D) 750 kg

**Question 4: Which gas is presented as the main greenhouse gas for emission reductions in this worksheet?**

- A) CO<sub>2</sub>
- B) NO<sub>x</sub>
- C) CH<sub>4</sub>
- D) N<sub>2</sub>

**Question 5: Rail transport of 24 tons of hydrogen per 400 km emits:**

- A) 120 kg CO<sub>2</sub>
- B) 160 kg CO<sub>2</sub>
- C) 80 kg CO<sub>2</sub>
- D) 100 kg CO<sub>2</sub>

**ANSWER KEY**

1.B / 2.C / 3.D / 4.A / 5.B

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