



# Greenhouse Gases Calculation of the Industrial Ecology Research Group (UPIBI-IPN)

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**Introduction.** The impact of greenhouse gases (GHG), responsible for the global warming, is such that Earth's temperature has increased 0.3 ° C over the last ten years (WMO 2011). Therefore it is important to calculate GHG emissions to see how much it contributes to global warming.

The Intergovernmental Panel on Climate Change (IPCC) has developed a methodology for the calculation of GHG in countries (IPCC 2006). This method does not give reliable results when applied to small industries or entities. The World Resources Institute (WRI) promotes calculation for small industries and institutions adapting the IPCC methodology (WRI 2010).

The WRI provides guidance for the calculation of emissions on small entities, divided into three scopes: A) Scope 1 (direct): coming from production process, B) Scope 2 (indirect): coming from the purchase of electricity and C) Scope 3 (indirect): from goods, services and personnel transport.

The Industrial Ecology Research Group (GIEI) that belongs to the Unidad Profesional Interdisciplinaria de Biotecnología from the Instituto Politécnico Nacional (UPIBI-IPN), joins the initiative in order to become a model for other small entities by calculating their GHG emissions.

## Methods.

1) Setting limits and reaches of the system

We defined the limits of the system, such as the place where the group GIEI operates. It was determined in what scopes existed emissions from the GIEI group.

2) Data Collection

Experimental: Measured in the GIEI group, consumption of electricity in the work area, transport of each of the members and travels.

Bibliographic: Emission factors and emission calculation equations, obtained IPCC, WRI and GEI (GEI México 2010) (CRE 2008).

3) GHG emissions calculation for GIEI group

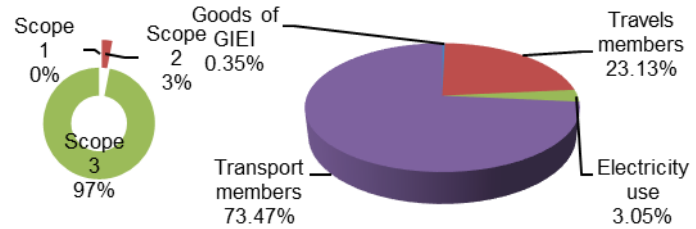
The calculations were performed according to the method of the IPCC guidance (2006) and the guide WRI (2010). The basic equation used is the following:

$$\text{Emissions CO}_2\text{e} = \text{Factor emission} * \text{Consumption} \quad \text{Equation 1}$$

4) Comparasion

The results were compared with the Instituto Tecnológico y de Estudios Superiores de Monterrey campus Guadalajara (ITESM-G) (ITESM-G 2010).

**Results.** The final account of GHG emissions of GIEI group is 5.56 t of CO<sub>2</sub>e. Figure 2 shows the emission calculated by GIEI group for scope and type.



**Fig. 1** Emissions by GIEI group for scope and type

The comparison GHG emission of GIEI group with ITESM-G as shown in figure 2.

Emissions t CO <sub>2</sub> e	GIEI	ITESM-G
Total (GIEI: scope 1 a 3)	5.56	3633.64
Per cápita (scope 1 y 2)	0.02	0.48
Per cápita (GIEI: scope 1 a 3)	0.62	0.48

**Fig. 2** Comparison of GHG emission

**Conclusions.** A complete GHG calculation was reported, as it comprises scopes 1 to 3, according to the WRI. Comparison of per capita emissions with ITESM-G, in scopes 1 and 2, showed that GHG emissions of GIEI group is 24 times lower than those from ITESM-G. GHG emissions calculation made by GIEI group may be a model for other educational or small systems. GHG emissions calculation is an important environmental toll that may be applied also to biotechnological systems.

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