Univerzitet u Beogradu
Poljoprivredni fakultet
Institut za poljoprivrednu tehniku
Naučni časopis
POLJOPRIVREDNA TEHNIKA
Godina XLI
Broj 3, 2016.
Strane: 1 – 6

University of Belgrade
Faculty of Agriculture
Institute of Agricultural Engineering
Scientific Journal
AGRICULTURAL ENGINEERING
Year XLI
No. 3, 2016.
pp: 1 – 6

UDK: 004.942

Originalni naučni rad
Original scientific paper

ESTIMATE OF GHG EMISSIONS - THE GREENHOUSE GASES - A UNIVERSITY CAMPUS IN CONNECTION WITH THE ELECTRIC ENERGY CONSUMPTION

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Abstract: The impacts of the use of electricity to the environment, both by environmental impacts, as for energy policy issues or because it is finite resources is a topic of great importance today.

The purpose of this paper is to establish the amount of GHG emissions - Greenhouse Gas, from electricity consumption on the campus of the University of São Paulo in the city of Pirassununga.

This quantification is carried out from the results of electricity consumption and emission factor. Emissions related to energy consumption have been established and from this inventory, goals can be traced for future projects related to energy efficiency and consequent reduction of GHG emissions - Greenhouse Gases.

Key words*: electricity consumption, energy efficiency, CO_2 emission factor, GHG - greenhouse gases*

INTRODUCTION

This item is on energy efficiency, energy consumption, CO_2 emission factor and GHG emissions - Greenhouse Gases.

Energy efficiency and electricity consumption. Energy security, international competition and climate change are increasingly driving the development and implementation of government policies on energy efficiency (IEA, 2010). [1]

Combating waste of electricity is advantageous for everyone involved. The consumer wins, passing a compromise smaller portion of their costs, the electricity sector, postponing investments necessary to meet new customers, and society as a whole, because besides the saved resources, energy efficiency activities generate jobs through

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the service itself and the use of equipment, almost entirely manufactured in the country and contribute to the preservation and improvement of the environment avoiding the environmental damage inherent in the construction of hydroelectric plants or the operation of thermal power plants (ELETROBRÁS, 2005). [2]

To invest in energy efficiency measures, it is essential for companies to gather information from all the technological options available, the benefits and costs of each option and the impact these technologies will have on production processes (for example, interruption of process production) (IEA, 2011). [3]

CO_2 emission factors. The average CO_2 emission factors for electricity to be used in inventories have to estimate the amount of CO_2 associated with a particular generation of electricity. It averages the generation of emissions, taking into account all the plants that are generating energy and not only those who are working in the margin. In this regard, it should be used when the objective is to quantify emissions from electricity being generated at any given time. It serves therefore to inventories in general, corporate or other (ENERGY FORUM, 2014). [4]

The inventory of GHG - Greenhouse Gases - is a tool to quantify the emissions of an organization that are associated with climate change, within internationally recommended criteria. As inventory the organization can assess its impact in this context of climate change, allowing action strategies are mounted for mitigation and prioritization of effective action to reduce emissions.

GHG emissions - Greenhouse Gases. Of all the activities that generate GHG - Greenhouse Gas, the energy sector is the largest contributor to global warming, and issued in 2005, 64% of GHG emissions in the world (IEA, 2008). [5]

At a time that global warming and climate change are of concern in the world, improving energy efficiency is the most cost effective and quick solution to minimize environmental impacts caused by the use of energy and reduce carbon dioxide (CO_2) (PETROBRAS, 2008). [6]

In Brazil, the high share of renewable energy in the energy matrix, mainly hydroelectricity, alcohol use in transport and sugarcane bagasse and charcoal in the industry make carbon dioxide (CO_2) by Use of relatively small fossil fuels. This difference in matrix composition puts Brazil in a favorable position relative to the global average, particularly with respect to GHG emissions - Greenhouse Gases (MCTI, 2010).[7]

According to there are several ways of reducing emissions of greenhouse gases and the effects on global warming. Reduce deforestation, invest in reforestation and conservation of natural areas, encourage the use of non-conventional renewable energy (solar, wind, biomass and small hydroelectric plants), prefer to use biofuels (ethanol, biodiesel) fossil fuels (gasoline, diesel fuel), invest in reducing energy consumption and energy efficiency, reduce, reuse and recycle materials, invest in low-carbon technologies, improving public transport with low greenhouse gas emissions, they are some of the possibilities. And these measures can be established through national and international climate policies (WWF, 2009). [8]

Research related to carbon dioxide release (CO_2) and other greenhouse gases - Greenhouse gases to the atmosphere were described by [9,10,11,12,13,14,15].

GHG emissions - greenhouse gas-related electricity use are described by [16,17,18,19,20].

MATERIAL AND METHODS

The study was conducted on the campus of Faculty of Animal Science and Food Engineering - FZEA the University of São Paulo - USP, in the city of Pirassununga - Sao

Paulo - Brazil. This campus is the largest of 'Campi' the University of São Paulo in area and is in fact an experimental farm with a total area of 23,333,204.00 m2 with perimeter 26535.55 m; and 80594.00 m^2 of built area (USP, 2013). [21]

The data on energy consumption on campus were obtained from a database with information about the USP energy bills called ContaluzWeb system.

Data from the emission factors related to energy consumption were obtained from the MCTI - Ministry of Science, Technology and Innovation (2015) [22] and the calculation of emissions was conducted using the methodology described in the CO_2 emission factors according to methodological tool "Tool to calculate the emission factor for an electricity system, versions 1, 1.1, 2, 2.1.0 and 2.2.0" approved by the Executive Board of the CDM - Clean Development Mechanism ".

The document "Tool to calculate the emission factor for an electricity system" is currently at version 5.0 and maintains the methodology used in previous versions. [23]

RESULTS AND DISCUSSION

They present the results for the monitoring and analysis of campus electricity bills, monitoring and analysis of the emission factors associated with electricity consumption and inventory / quantification of GHG emissions - greenhouse gases related to electricity consumption.

Electricity Consumption. By ContaluzWeb system was checked the power of the campus consumption for the year 2014, as listed in Tab. 1.

Table 1. Electricity consumption on the university campus in 2014

Electricity Consumption (MWh)											
Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
340,4	*363,9*	*366,8*	*381,6*	*372,1*	*343,1*	*334,0*	*339,7*	*355,9*	*400,6*	*428,2*	*377,8*

CO_2 emission factor. The Ministry of Science, Technology and Innovation, organ of the Brazilian Government, releases the CO_2 emission factors for electricity generation in the SIN - National Interconnected System of Brazil from the base year 2006. This data is available on average annual, monthly, daily and hourly.

The average CO_2 emission factors for electricity to be used in inventories have to estimate the amount of CO_2 associated with a particular generation of electricity.

By MCTI (2015) [22], is listed in Tab. 2 CO_2 emission factor measured during the year 2014 in the SIN - National Interconnected System of Brazil.

Table 2. CO_2 emission factor in SIN - Brazil's National Interconnected System in 2014

CO_2 emission factor (tCO_2/MWh)											
Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
0,091	*0,117*	*0,124*	*0,131*	*0,142*	*0,144*	*0,146*	*0,158*	*0,143*	*0,141*	*0,151*	*0,137*

GHG emissions - Greenhouse Gases. According to MCTI (2015) [22], that all electricity consumers in the SIN - National Interconnected System - calculate their emissions by multiplying the energy consumed by this emission factor, the sum corresponds to emissions of CO_2 emissions. Tab. 3 lists the monthly CO_2 emissions in 2014 to the university campus.

Table 3. CO_2 emission in 2014

CO_2 emission (tCO_2)											
Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
31,0	*42,5*	*45,4*	*50,0*	*52,9*	*49,4*	*48,9*	*53,6*	*50,9*	*56,6*	*64,8*	*51,7*

Chart 1 are the amounts of CO_2 (t CO_2) related to electric power consumption in 2014.

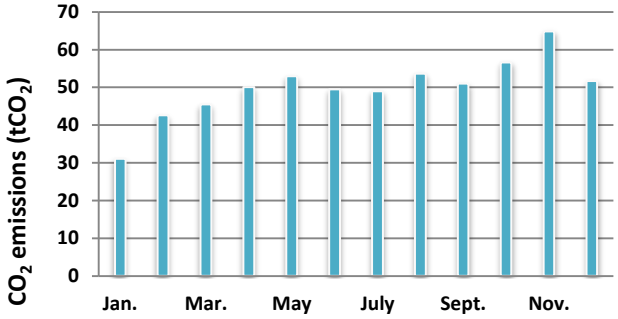

Figure 1. CO_2 emissions (tCO_2) related to electricity consumption in 2014

A trend of increasing CO_2 emissions was observed (t CO_2) every month in the year 2014. The monthly average emission was estimated at 49.8 (t CO_2) on the university campus related to the consumption of electricity. In the year 2014 it was issued a total of 598 (t CO_2).

CONCLUSIONS

CO_2 emissions related to the consumption of electricity on the campus of the University of São Paulo in the city of Pirassununga were quantified and this inventory is intended to set goals for future projects related to energy efficiency to reduce greenhouse gas emissions - Gases Greenhouse.

In times of global warming, the effects of the high standards of production and consumption lead to global society, companies and public institutions to reflect deeply on issues related to sustainability in different views, such as the environmental economic and social and researching new forms of energy development that are compatible with sustainable development.

It is intended with the data and results of this project show that when consuming electricity is issued a significant amount of GHG - Greenhouse Gases. One of the expected effects of the disclosure of this inventory in the community's awareness to change consumption habits and reduce electricity consumption.

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PROCENA GHG EMISIJA – GASOVA STAKLENE BAŠTE – UNIVERZITETSKOG KAMPUSA U ODNOSU NA POTROŠNJU ELEKTRIČNE ENERGIJE

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Sažetak: Uticaj električne enrgije na okolinu, kako zbog zaštite okoline, tako i zbog potrošnje energije iz neobnovljivih izvora je danas veoma važna tema.

Cilj ovog rada je da odredi količinu GHG emisija – gasa staklene bašte, iz potrošene električne energije u kampusu Univerziteta São Paulo u gradu Pirassununga.

Procena je izvedena iz rezultata potrošnje električne energije i faktora emisije. Procenjene emisije u odnosu napotrošnju energije mogu da posluže za buduće projekte iz oblasti energetske efikasnosti i smanjenja emisija – gasova staklene bašte.

Ključne reči*: potrošnje struje, energetska efikasnost, factor CO_2 emisije, GHG – gasovi staklene bašte*

Prijavljen: *Submitted*:	29.01.2016.
Ispravljen: *Revised*:	
Prihvaćen: *Accepted*:	03.09.2016.