F8 - SIMPLIFIED METHOD OF EVALUATING EMISSIONS OF GHGS CAUSED BY THE ACTIONS OF MANAGEMENT PROGRAMS OF WATER DEMAND

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Abstract

Emissions of greenhouse gases (GHG) are currently configured as one of the most important challenges worldwide, and integrated actions to identify and minimize these emissions are expected also in national and local level. In Brazil, at the local level, the 'Programa de Uso Racional da Água' (Water Conservation Program - PURA), have a potential to reduce GHG emissions in urban systems, since the interventions in building systems have potential to reduce water consumption, generating impacts in both plumbing systems and urban water and sewage systems.

The purpose of this research is to develop a simplified method for evaluating the GHG emissions caused by the actions of management programs for water demand. It is intended that with this method, to perform an assessment of the impact of actions to reduce GHG emissions in urban systems of collecting and treating sewage. To develop the simplified method are being collected the data of GHG emissions of the management options for water demand system applied and the known data of GHG emissions provided by public utility company - SABESP. The simplified method will be validated on the actions of management of water demand of the –Water Conservation Program of University of Sao Paulo - PURA-USP for building plumbing systems of the University of Sao Paulo buildings and its impacts on the local public water system. The expected results are: (a) Simplified method for collecting, managing and monitoring of GHG emissions data for easy use by the managers of PURA (b) indicators of GHG emissions for the decisions of the actions of programs, (c) criteria for systemic analysis of the impacts of the actions of PURA in the urban system, (d) results validation in the urban system SABESP (e) knowledge of the carbon balance in water management.

Keywords

Management of water demand, emissions of greenhouse gases, plumbing systems, water conservation.

1 Context and Rationale

The scarcity of natural resources is a global concern, which can be seen in the increasing emergence of actions for the management of these resources. Example of this natural resource for water is the definition of one of the goals of the Millennium Development Goals proposed by the United Nations Development Programme - UNDP *"to ensure environmental sustainability by increasing the proportion of population with access to safe sustainable drinking water "*[1].

For a proper analysis of the impact of water scarcity, and for taking comprehensive action to reduce these impacts, it is appropriate to consider, in addition to the sustainable approach, an interdisciplinary approach involving other aspects and sectors.

According to data from the Agência Nacional de Águas - ANA [2] on the water balance of the main Brazilian rivers, the situation in Brazil is considered comfortable, especially for high water availability in the Amazon Basin region. However, specifically for the city of São Paulo, the situation is opposite, with high demand for water use and low water supply in the city.

In order to promote the rational use of public water supplies, the Programa Nacional de Combate ao Desperdício de Água (National Program to to Reduce Water Losses and Water Consumption) - PNCDA [3] was a reference in developing the Programa de Uso Racional da Água no município de São Paulo (Water Conservation Programin the municipality of São Paulo), known as PURA-SABESP [4], operating mainly on water consumption.

Complementing the PURA-SABESP program's actions, in 1997 the University of São Paulo began the program PURA-USP deploying its actions in the units located in Cidade Universitária Armando de Salles Oliveira – CUASO, including building systems with total building area of approximately 740,000 m^2 . The PURA-USP program objectives, according to SILVA [5], includes the reduction of consumption through technological and behavioral actions, with the implementation of a structured management of water demand and the development of methodologies that support decision making in implementation of program actions.

TAMAKI [6] summarizes and demonstrates the benefits of the PURA-USP program, highlighting the improvement in the monitoring of supply and demand management units on campus, enhancing the benefits of water submetering.

[1] It consists of an approach in which two disciplines intentionally establish connections and links between each other to achieve a more comprehensive, while diverse and unified. (PHILLIPI Jr. A, et all, 2000)

In the implementation of PURA-USP program, according to TAMAKI [6] was adopted a new governance structure on campus, which has remedied the difficulties in identifying responsibilities and availability of data required for early intervention activities in building systems. It was found that the actions of the program PURA-USP qualitatively and quantitatively improved demand management of water, while applying the actions of rational use guidelines in buildings proposed by OLIVEIRA [7], such as audits of water use, diagnosis of water use plans, interventions and evaluations of the impact of reducing water consumption.

The actions of intervention in plumbing systems are monitored and reported by the committees of the program PURA-USP and, according to GONÇALVES [8], the effects of the implementation of PURA-USP were perceived on the changes in the supply system and sanitary equipment, such as systems, reservoirs and water meters; restoration and adequacy of the cold water supply, restoration and upgrading of sanitary fixtures, including replacement of the same by saving models, thus leading to the change in water consumption . In the period 1998 to 2010 the results of average monthly demand of water showed a reduction of 49%, with 137,881m^3/month in 1998 to 70,531m^3/month in 2010. This variation of water demand is directly reflected in the reduction in the volume of water supply, sewage collection and treatment system conducted by the municipality, this being the motivator for the development of evaluation method for analysis of these impacts which consequently provide a reduction of GHG emissions

In parallel to efforts to minimize environmental impact with respect to water, other activities are conducted in order to minimize environmental impact in relation to climate change, as the National Plan on Climate Change - PNMC [9], which has focus on the process of accumulation of greenhouse gases in the atmosphere. For Brazil, as a signatory and does not belonging to Annex I of the Kyoto Protocol, its obligations are focused on actions and initiatives that impact positively on reducing emissions, such as the creation of clean development mechanism, energy efficiency incentives and waste management. As one of the actions undertaken in this context, Brazil has developed and updated its National Inventory of anthropogenic emissions and removals of greenhouse gases not controlled by the Montreal Protocol[2].

As determined by the Convention - the United Nations Framework on Climate Change - UNFCCC [10] for signatory countries, only the anthropogenic emissions and removals of greenhouse gases that are produced as a result of human actions are considered for the National Inventory.

In Brazil, data bases on the performance of processes and organizations are structured, and their emissions inventoried as proposed by the Brazilian program to prepare volunteer inventory in the industry - Brazil GHG Protocol [12].

Thus, the Brazilian National Inventory [11] presents its results, which for the treatment of sewage effluent in a high degree of organic content there is great potential of CH4 emissions, in particular the domestic and commercial sewage. As for the case of domestic sewage, depending on the nitrogen content in food occur also N_2O emissions. This information justifies the actions for waste management, particularly reduction in sewage treatment, which would have positive impacts on the amount of greenhouse gas emissions.

At the state level, the State of São Paulo had its first inventory of anthropogenic direct and indirect emissions of greenhouse gases on base year 2005 [13], which also includes the data of GHG emissions for the treatment of domestic sewage and industrial .

As a result the inventory shows that the waste sector in Brazil represents 1.9% of GHG emissions and for the State of São Paulo this same sector represents 6.7% of their total emissions.

In the State of São Paulo for GHG emissions to the waste sector, 37% are emissions related to the treatment of domestic and industrial effluents, demonstrating different sceneries for GHG emissions than the reality in the country to the same sector.

Following the same guidelines of the Brazilian program in the water sector, the local public utility [14] applied the methodology proposed by the Brazilian program calculated the GHG Protocol and its emissions for the base year 2007, which has in its inventory-related emissions effluent treatment at their stations represent 88.72% of its GHG emissions.

[2] The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty in which the signatories undertake to replace substances that appear to be reacting with ozone (O3) in the upper stratosphere. The treaty was opened for signature in 1987 and entered into force in 1989, with membership of 150 countries and was last reviewed in 1999.

The GHG inventory of SABESP [14] includes in its scope the system-related data collection and urban sewage treatment, own vehicle fleets, stationary engines, generators and machinery, consumption of electrical energy used in the treatment and outsourced fleet. Excluded from this inventory are: data relating to water treatment, sludge WTP, WWTP sludge for landfill, refrigerants and insulators, solid waste services, taxis and the use of water truck.

On the part of water utility company, the action to inventory their emissions performance demonstrates a conscious and planned process for wastewater treatment. However, are not included in the inventory analysis of impacts from demand management actions to reduce emissions and emissions related to water supply, proposed in this research.

The results presented in the management of water demand and inventories of emissions from municipal collection systems and sewage treatment will be addressed in developing the simplified method proposed in order to demonstrate the interdisciplinary approach to climate change and water management.

2 Research Objectives and Development

The aim of the research reported in this paper is to develop a simplified model for the evaluation of GHG emissions caused by the actions of management programs for water demand and the consequent impact on reducing GHG emissions in urban systems of water supply and collection and treatment sewage. Being a research to evaluate GHG emissions involving the management of water demand management, it is intended that it provides:

• A collected database of GHG emissions management options for water demand, considering the data provided by PURA-USP program and the major vendors involved in the operational limits defined in the survey.

• An application of a method for further evaluation and quantification of GHG emissions in a spreadsheet, for ease of use.

• The results illustrated by the actions identified in the base year 2010 by the Program PURA-USP and future actions to be undertaken by the program.

• Reporting and analysis of the impacts of program activities PURA-USP in GHG emissions of the urban system SABESP collection and treatment of sewage, striving for a balance of carbon in the actions of demand management programs.

For the development of research a review of the literature on global warming issues and climate change, emissions of greenhouse gases, methods of inventory, life cycle in water management, building systems and urban programs and actions of rational use of water was needed.

The reasons for exclusions and uncertainties are under review and may be considered at the moment:

(a) simulation of the information related to the displacements due to lack of information materials logistics, from production to distribution to use;

(b) the quantification of GHG as just an additional factor in the analysis of water management, it is not the only one;

(c) non-cost evaluation of carbon, social or economic benefits;

(d) the life cycle analysis in its fullness, due to lack of data and justification for using the concept of life cycle defined and limited;

(e) data collection related to the selected base year shall be examined with caution due to uncertainties in its information from manufacturers and suppliers.

(f) the exclusion of the quantification of emissions related to the dismantling and construction activities related restructuring actions of the measuring system and replacement of devices and equipment of the interventions made by the programs of rational use of water.

The expected results are:

(a) Knowledge of the amount of CO_2e emissions related programs for the actions of rational water use;

(b) Development of a simplified method for collecting and managing data for carbon accounting and easy to use program managers for the rational use of water;

(c) Validation of the proposed model effectively to the development of indicators that support decision making for the actions of the PURA;

(d) Analysis of the systemic impact in reducing GHG emissions in the public sewage collection and treatment of a city;

(e) Analysis of the impacts of reduced water consumption in the case study PURA-USP in sewage systems SABESP by decreasing the flow of sewage to be collected and treated.

(f) Knowledge of the carbon balance in water management for the development of new interdisciplinary strategies to minimize environmental impacts.

3 The Simplified Evaluation Method

For the development of the simplified method was considered the approach of Life Cycle Assessment (LCA), which according BESSA [15] is a method of assessing the environmental effects of a product, process or activity throughout the life cycle . In the LCA method development contributed to the identification of environmental aspects of the systems involved in the production chain of the program of water conservation and urban systems. This made it possible to define the scope, the functional units and boundaries for the proposed method (Figure 1).

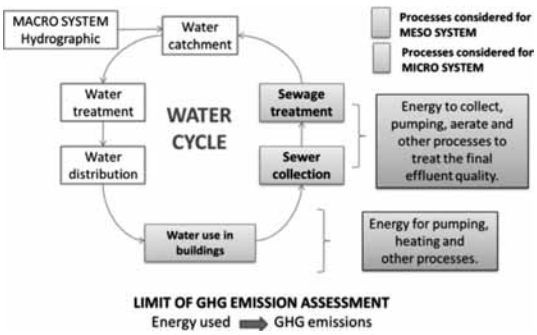


Fig.1 : Life cycle analysis in water management

The simplified method is based on OLIVEIRA [7], when considering the building systems, plumbing systems as microsystem and urban water supply and sewage treatment as mesosystems, as shown in Figure 2.

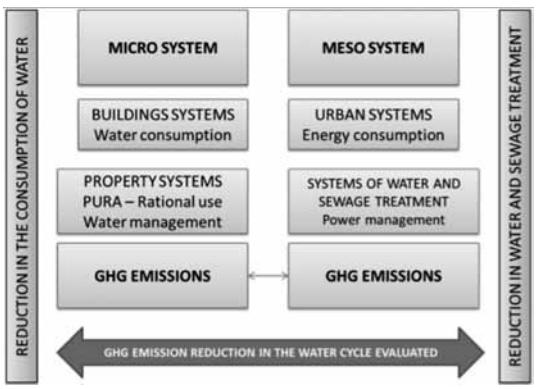


Fig.2 : Method structure

For the micro and meso systems will be identified systems used for water supply and sewage treatment, building equipment and plumbing components, the information to quantify GHG emissions and related information and data management systems involved, through additional contacts with manufacturers and distributors involved in the production chain of these systems, public urban system developers and PURA coordination program. The environmental impact of water losses will be based on data provided by management systems, reversing the losses of water in carbon emissions. The water savings generated will be considered as a positive environmental impact in reducing GHG emissions in urban systems.

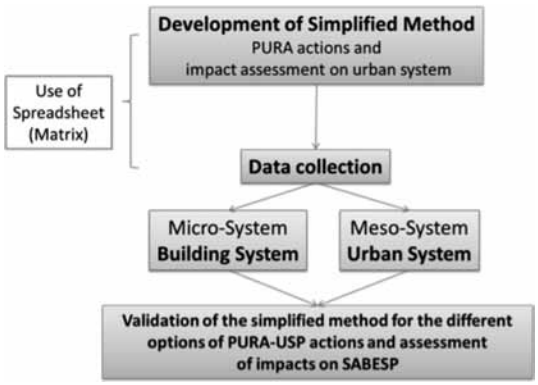
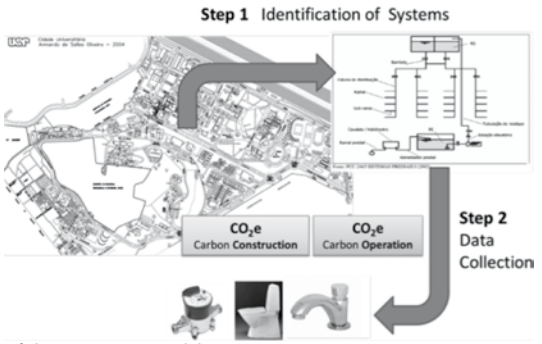


Fig.3 : Method illustration

For the application of the method is necessary to meet the three steps to building the system object of analysis in GHG emissions, as follows: Step 1 - Identification of systems, Step 2 - Data collection (Figure 4) and Step 3 - Use and application



of the Matrix (spreadsheet).

Fig.4 : Step 1 and 2 – Identification of Systems and Data Collection

After identification and data collection is proposed a simplified method for calculating emissions in order to facilitate the handling of data and understanding of the results (Figure 5). It will be developed a matrix (spreadsheet) for the compilation of data collected by its simplicity of use for the computation and data management of GHG emissions.

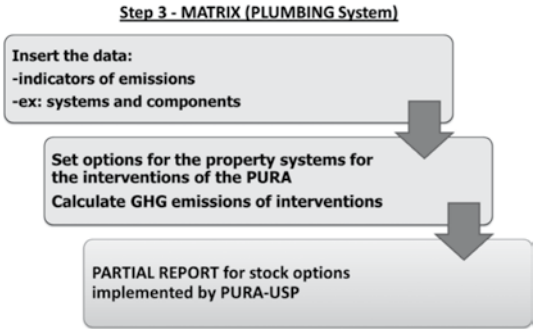


Fig.5 : Step 3 – Plumbing System

For the urban system, the development of the Step 3 - Use and application of the spreadsheet, the data will consider emissions inventoried by the manager of the urban system (figure 6).

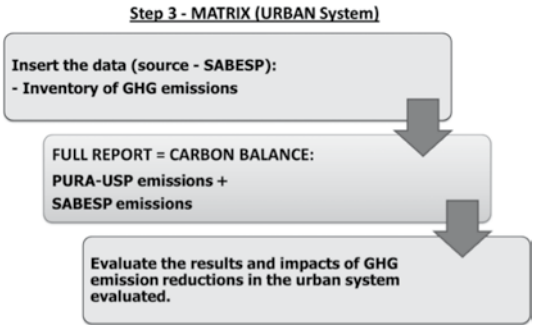


Fig.6 : Step 3 – Urban System

In the measurement of emissions the simplified model also considers the guidelines requested by the NBR ISO 14064-1:2007 [16] and also includes recommendations on complementary demand management program:

(a) policy and strategy;
(b) Description of actions directed;
(c) emissions and removals of GHG by buildings;
(d) Description and outcomes of the uncertainties and the means of administration;
(e) Presentation of indicators;
(f) Description of information management by the coordinators of the program;
(h) documented procedures for data collection and monitoring of GHG emissions.

The values will be, through the simplified method, known and understood as emissions related to each m^3 of water saved.

Knowing the inter-relationship (Figure 7) will be possible to analyze the volumes of water saved by the actions of programs for rational use of water in urban systems and reflect the reduction of volume of water and sewer and therefore the reduction of GHG emissions rated in the life cycle.

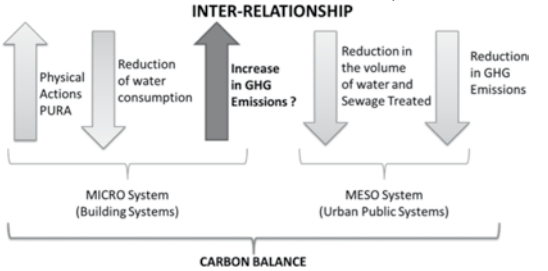


Fig.7 : Inter-relationship and carbon balance (partial)

It is intended to illustrate the different options for the individual and combined hydraulic systems, considering the scenario of water demand management in the building for the validation of this simplified method will be in the buildings of the University City campus of USP for demand management through the program PURA-USP and urban water supply systems and sewage treatment SABESP by knowledge of the emissions through their inventories.

For the meso urban system of water supply and sewage collection and treatment is expected to at least collect the data from direct emissions and removals related to the processes of collecting and treating wastewater, transport fleets, stationary engines, generators and machinery and emissions, indirect emissions related to electricity in the treatment of fleets and subcontractors involved in the case.

As a result, the simplified method will provide information that will provide the carbon balance and the quest for balance in decision-action programs in water conservation, in order to support the decision.

The output of the matrix includes graphics that illustrate carbon emissions to the Carbon Construction and Carbon Operation in the planning period to be considered. Information related to water conservation and reduction in the volume of treated sewage, for example, will be highlighted in order to demonstrate the end user the need for complementary vision of GHG emissions in terms of water demand management.

4 Concluding remarks

The reduction in water provided by demand management programs through the rational use of water, potentially generate a reduction in greenhouse gas emissions because they reflect directly on reducing the supply of urban water supply system and reducing volumes to be treated in the stations sewage treatment.

The data generated by the simplified method of evaluating emissions provide new indicators that complement the analysis of the sizing of water supply and sewage treatment, centralized or decentralized management of urban systems in a particular region or group of buildings.

The contribution of the interdisciplinary approach of water management and air emissions is relevant to understanding the context of climate change and its impacts. Identify issues and develop proposed in a simplified method, involving operational activities in managing water demand, can directly contribute to the education of managers and users of a building system, in relating the reduction of water consumption to reduce emissions gas emissions.

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6 Authors' Presentation

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