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The Perspectives of Biomethane to Contribute to Increase the NG Supply

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Research Centre for Gas Innovation

Academic Work

Outline

- Summary of GBio, RCGI and RCGI's Project 27
- Contextualization
- Methodology
- Biogas/biomethane potentials
- Results
- Conclusions

GRUPO DE PESQUISA EM BIOENERGIA
Universidade de São Paulo | Instituto de Energia e Ambiente

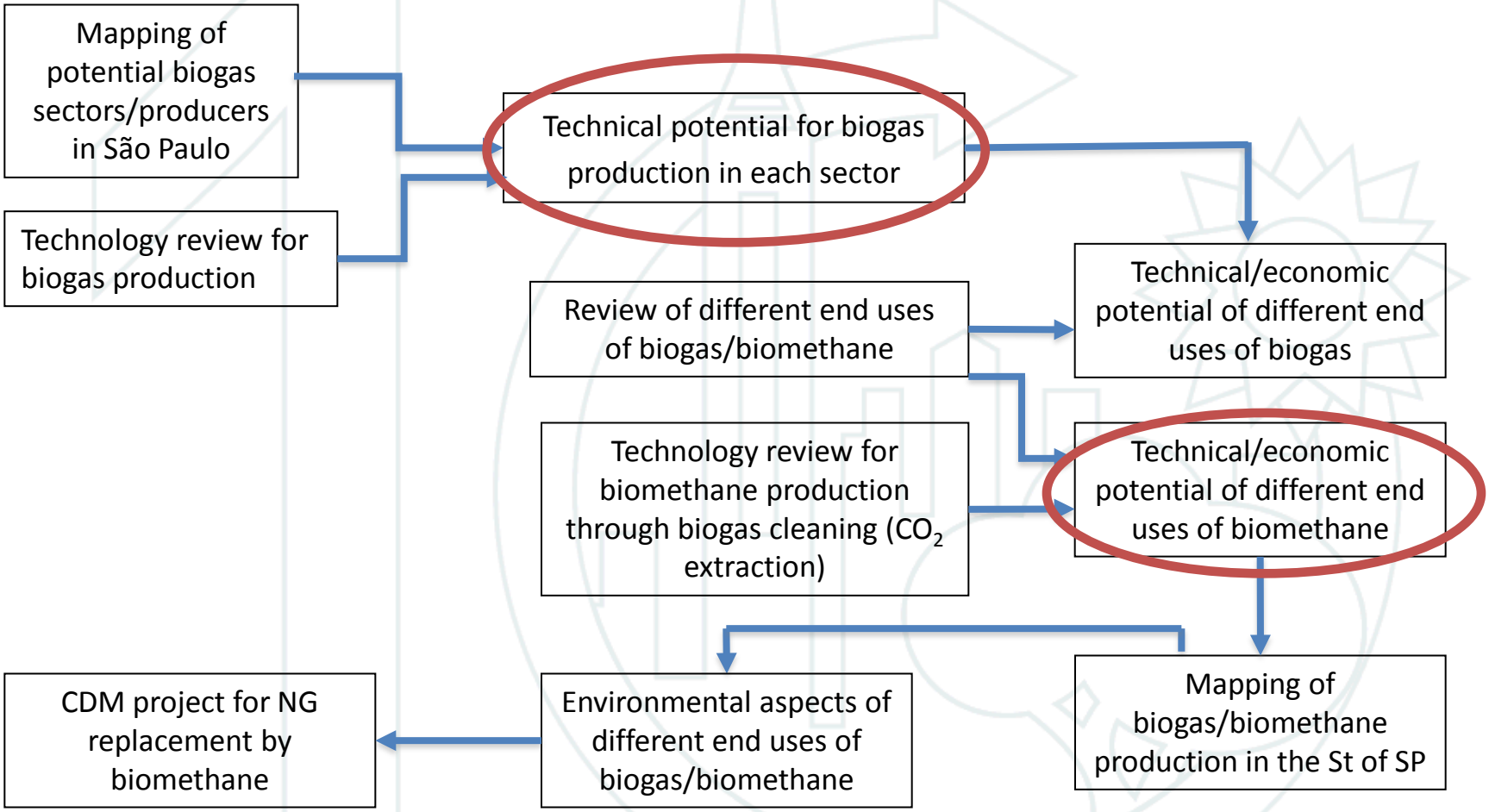
- **Base:** Institute of Energy and Environment of the University of São Paulo
- **Coordination:** Prof. Suani T. Coelho, PhD
- **Special Contribution:** Dr. José Goldemberg, PhD
- **Research team:**
  - 5 Postdoc and PhD fellows
  - 6 PhD candidates
  - 2 MSc students
- Researching bioenergy since 1996
- www.iee.usp.br/gbio

Research Centre for Gas Innovation

- RCGI - Research Center for Gas Innovation
- World center for advanced studies regarding the sustainable use of natural gas, biogas, hydrogen, and management, transportation and storage of CO2 emissions.
- Based at the Polytechnic School of the University of São Paulo
- Result of FAPESP partnerships with Shell
- Research, innovation and diffusion of knowledge.
- Engineering, Physical Chemistry and Energy Policy and Economics projects.
- Currently: 29 projects
- www.rcgi.poli.usp.br

RCGI Project 27

- Project objectives
  - Analysis of the perspectives for biogas and biomethane (from urban and rural sources) in the State of Sao Paulo; geo-referenced mapping
  - Analysis of environmental benefits of increasing the biogas/biomethane share in the energy matrix of São Paulo State
  - Analysis of standards for biomethane injection into NG grid, as well as the other biomethane final uses, such as in automotive vehicles and biogas for decentralized electricity generation.
- CDM Project
  - Development of a CDM project based on biomethane injection into NG grid
  - The CDM project will be based on the simulation of the potential GHG emissions reductions due to NG replacement by biomethane.
  - CDM project to be submitted to UNFCCC as a project deliverable


Mapping of potential biogas sectors/producers in São Paulo
Technology review for biogas production
Technical potential for biogas production in each sector
Technical/economic potential of different end uses of biogas
Review of different end uses of biogas/biomethane
Technology review for biomethane production through biogas cleaning (CO_2 extraction)
Technical/economic potential of different end uses of biomethane
Mapping of biogas/biomethane production in the St of SP
Environmental aspects of different end uses of biogas/biomethane
CDM project for NG replacement by biomethane

Contextualization

- Uses for biogas and biomethane
  - Power generation (gas turbine, CHP)
  - Thermal use (heat)
  - Diesel and gasoline substitution (vehicular use)
  - NG substitution (injection on the grid)
- Paris Agreement: C emissions reduction
  - By 2025: reduction of 37% compared to 2005.
  - By 2030: reduction of 43% compared to 2005.
- São Paulo State Climate Policy (2009)
  - Reduction of 20% on GHG by 2020 when compared to 2005;
- Legislations to promote the injection of biomethane into the gas grid
  - São Paulo, Rio de Janeiro, Espírito Santo and Rio Grande do Sul




Contextualization

- Regulatory environment
  - Brazil:
    - ANP Technical Note N. 157.2014 SBQ RJ, Sep 17, 2014;
    - ANP Resolution N. 08/2015, Jan 30, 2015;
    - ANP Resolution N. 03/2017 (public consultancy) → **Regulates the injection of landfill upgraded biogas**

Forbids injection of landfill upgraded biogas (siloxanes)

  - Europe
    - Regulations being discussed since 2012;
    - Uses for electric energy, heat, vehicular use and injection on the grid;
    - Alternative use of NG;
    - Injection: Climate change solution/barriers

Methodology

- Literature review
  - Biogas, biomethane, biogas sources, biogas and biomethane production;
  - Energy conversion options for biogas and biomethane;
  - Existing legislations in Brazil and experiences on other countries (mainly policies in European Union);
- Biogas potential assessment from different sources
  - Residues production estimatives (MSW, Sewage, animal residues and vinasse)
  - Residue to biogas indexes;
  - Estimation of biomethane produced from biogas
- Focus: São Paulo State

Biogas potentials

- Landifils
  - Brazil still has only 58% of MSW disposed adequately (more than 1,500 dumping disposals, most in Northeast region - lowest HDI)[1].
  - Federal law 12.305/10 - National Policy on Solid Residues (NPSR)
  - Biogas naturally produced at the landfill (under anaerobic conditions)

- Sewage
  - Brazil still has only 55,2% of sewage collecting and only 51,7% of those receives treatment [2]
  - São Paulo: high collection of sewage, but little treatment (raw dumping)
  - Biogas is produced in bioreactors, but it is not energetically used (flaring)

[1] IPEA, 2013
[2] IBGE, 2008

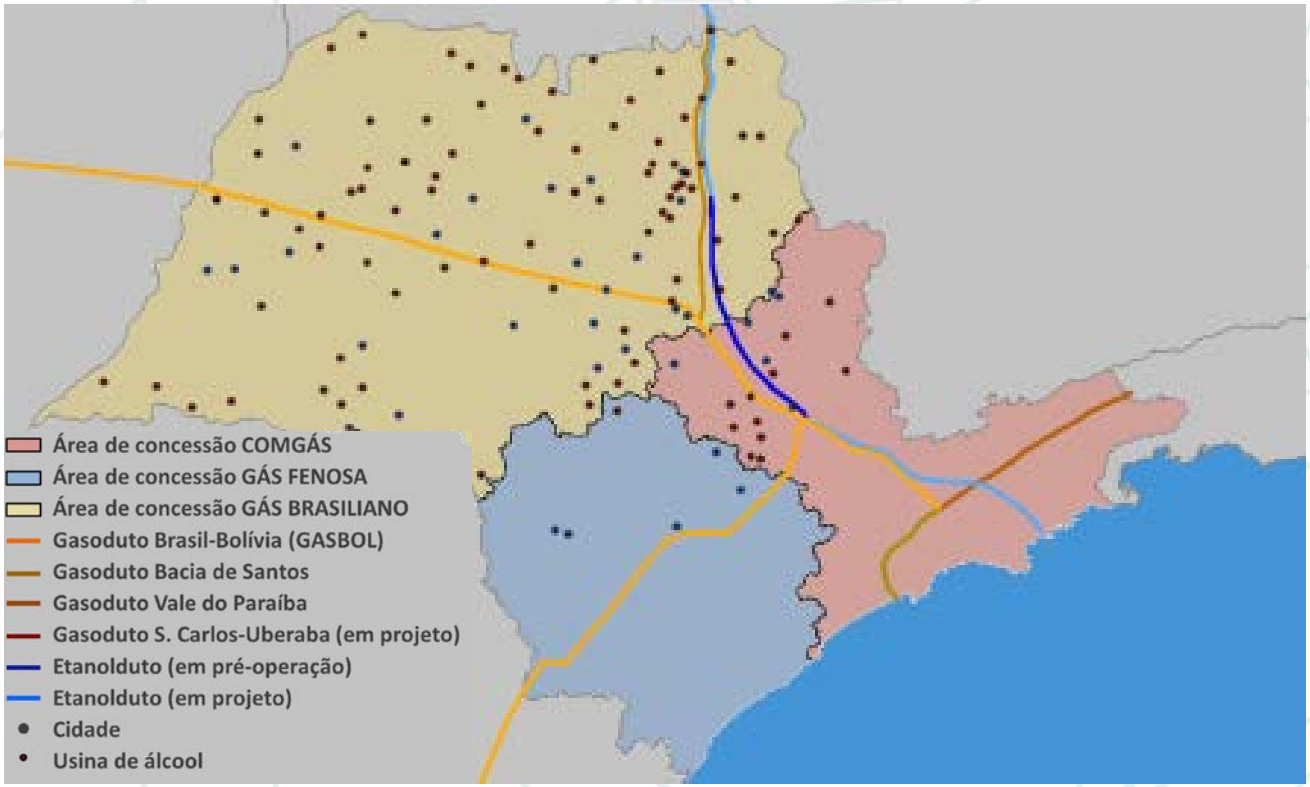
Biogas potentials

- Animal residues
  - Brazil still has an extensive animal production system
  - treatment of waste from animal creations becomes a necessity due to the high content of organic matter
  - Poultry residues are better for biogas production when compared to pig and cattle residues[1]
  - Biodigestion in UASB or covered lagoon reactors;

- Agroindustry
  - São Paulo is the biggest producer of sugarcane and ethanol (14,6 MML)[2]
  - Focus: sugarcane and ethanol plants residues (vinasse)
  - In Sao Paulo State, CETESB controls the amount of vinasse disposed in the soils (fertigation)
  - Biodigestion in UASB reactors (long residence times);

[1] MAHADEVASWAMY & VENKATARAMAN, 1986
[2] UNICA, 2017

Biogas Potentials



Source: Joppert et al, 2014

Results

Biogas source	Estimated biogas production (10^6 m³/year)	Estimated biomethane production (10^6 m³/year)
Landfills	2,419.43	1,209.72
Sewage treatment	430.99	215.49
Animal residues	132.75	66.38
Vinasse	2,610.41	1,501.03
Total – São Paulo	5,593.58	2,992.62

NG consumption in São Paulo State (2014)[1]: **6,181.82x10^6 m³ /yr**

48% of the demand for NG in the São Paulo State

[1] Secretaria de Energia do Estado de São Paulo, 2014

Results

Biogas source	Potential power output (MW)	Estimated electric energy output (GWh/year)
Landfills	495.0	3,769.0
Sewage treatment	88.0	671.0
Animal residues	26.0	207.0
Vinasse	798.0	4,067.0
Total – São Paulo	1,407.0	8,741

NG consumption in São Paulo State (2014)[1]: **150,723 GWh/year**

5.8% of the demand for EE in the São Paulo State

[1] Secretaria de Energia do Estado de São Paulo, 2014

Conclusions

- The preliminary results show the important contribution of biogas and biomethane to emissions reduction in São Paulo and to reach the goals of Paris Agreement;
- Biomethane produced from vinasse, alone, can contribute to, theoretically, reduce almost the amount to be reduced according the São Paulo State Climate Policy (diesel replacement);
- This is the main reason for the contribution of Project 27 in RCGI: to contribute to reduce carbon emissions in Brazilian energy matrix, through the replacement of fossil fuels, besides the strategic benefits of increasing the natural gas offer.

Thank you!

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Thanks to:

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