Municipal wastewater treatment in Latin-America:

A zoom to Mexico with emphasis in GHG emissions from municipal wastewater treatment

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Presentation Outline

- Introduction: Sanitation in Latin America and the Caribbean (LAC)
- Status of municipal wastewater technologies in LAC
- Methane in wastewater treatment (WWT)
- Methane emission scenarios for municipal WWT in Mexico
- Final remarks

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Introduction

Basic sanitation in Latin America and the Caribbean (LAC)

- 578 million inhabitants (8 % World population)
- Water supply for 93 % of its population **(40 millions lacking)**
- Sanitation for 79 % of its population **(120 millions lacking)**
- Wastewater treatment for around 20%
- Sanitary landfills receive 54% of municipal solid wastes (MSW) in Latin America. Open dumps are used for 23 % MSW.
- Huge needs of capital investment in basic sanitation and environmental protection
- 18% of global GHG emissions

Introduction

- New approaches, new solutions for a persistent problem
  - Innovative
  - Adapted
  - Holistic (finances, management, technology, environment, social participation)

- Wastewater treatment and municipal solid waste disposal contribute to the emission of greenhouse gases (methane)

- Need to identify wastewater treatment systems with lower environmental impact and lower carbon footprint for LAC

- Adoption of these technologies will promote sustainable development.

Introduction

- Sustainability and climate change issues are increasingly important in local, regional and global levels.

- Anaerobic digestion is an increasingly applied process for wastewater treatment in LAC.

- Low energy requirements and biogas production as a source of renewable energy are major assets for anaerobic digestion.

- Several research groups in Latin America have provided a significant contribution to the scientific knowledge and technology development of anaerobic processes.

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UNAM-IDRC Project 105701-001

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WATER AND SANITATION: LAC CITIES ADAPTING TO CLIMATE CHANGE BY MAKING BETTER USE OF THEIR AVAILABLE BIOENERGY RESOURCES

A three years project (2010 -2013) funded by the IDRC (International Development Research Council) of Canada.

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Goal (conceptual):

Evaluate the environmental impacts of the most representative water treatment technologies in Latin America and the Caribbean in order to identify mitigation strategies

Specific goals (+):

- To develop an inventory of treatment technologies in LAC
- To generate representative treatment scenarios of LAC
- To identify the technical and economic characteristics of representative scenarios
- To assess the environmental impacts of treatment scenarios with emphasis on the quantification of GHG through Life Cycle Assessment (LCA)
- To identify research topics in order to minimize environmental impact and GHG generation for the identified (improved) wastewater treatment technologies.

Treatment technologies inventory for LAC

✓Six countries: Brazil, Colombia, Chile, Dominican Republic, Guatemala and Mexico

✓The information was collected from official agencies, organizations and WWTP operators through a consultant engineer in each selected country.

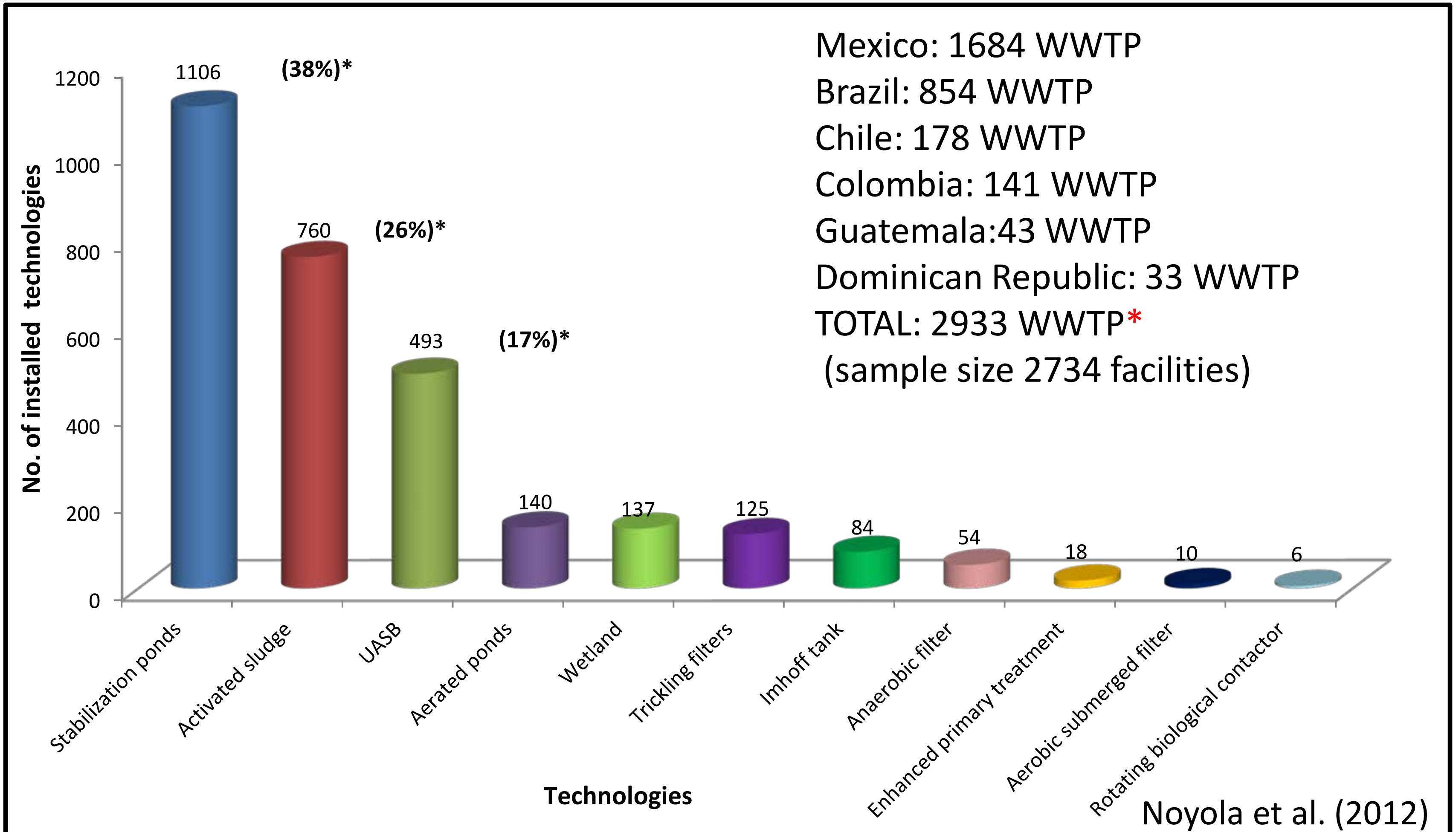
✓2734 WWTP in the final sample (from an estimated universe of 5500)

Data base template:

a) General data (2734 WWTP)
b) Specific data (155)
- Wastewater quality
- Sludge, biosolid and solid waste
- Emissions and odour control
- Costs

Processes applied for wastewater treatment in selected countries

Distribution per technologies

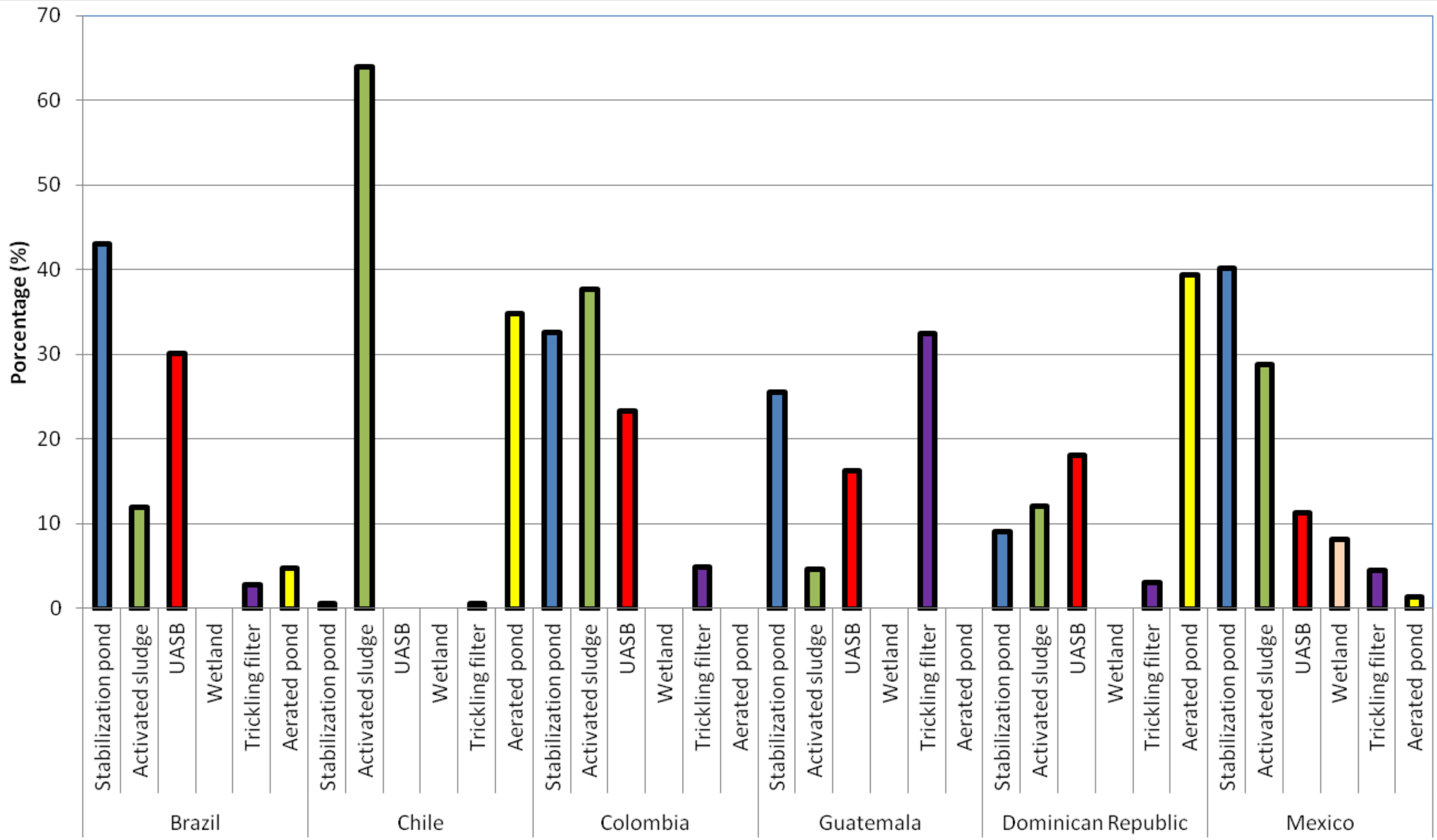


The 3 most used technologies, count for 80% of the total sample of WWTP

- The septic tank was not considered as technology for the treatment
- * 199 WWTP that reported combined processes (two technologies) were counted independently.

Processes applied for wastewater treatment in selected countries

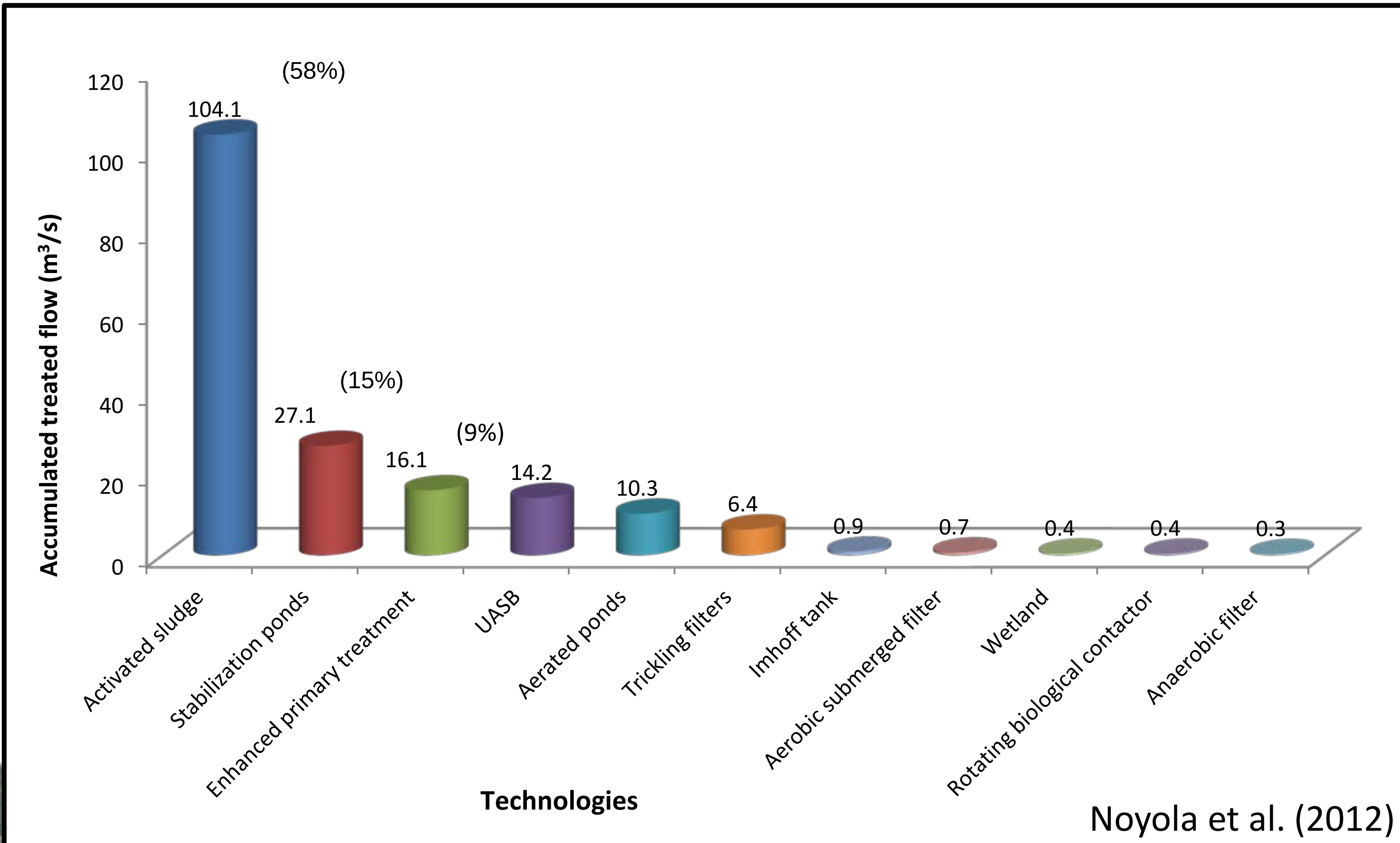
Distribution per countries



Noyola et al. (2012)

Processes applied for wastewater treatment in selected countries

Treated flow per type of technology



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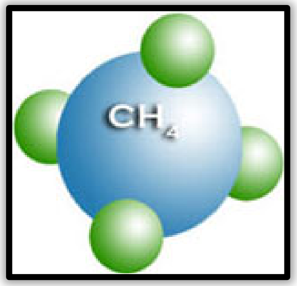
CH_4 and CO_2 in WWTP

•Wastes produce around 25% of atmospheric methane and their proper handling is becoming a major point of concern for effective mitigation actions.

•Methane is the main short –lived climate forcer (SLCF) and is receiving greater attention in CC mitigation strategies.

•Wastewater treatment may produce methane, depending on the chosen technology and its operation.



CH_4 and CO_2 in WWTP

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- Wastewater treatment facilities may be intensive in energy use, depending on chosen technology.

- Electricity requirements for wastewater treatment has a direct impact on CO_2 production at the generation facility.

- Research and technology innovation opportunities for developing treatment processes with reduced GHG emissions and carbon footprint in the area of organic residues and wastewater management.

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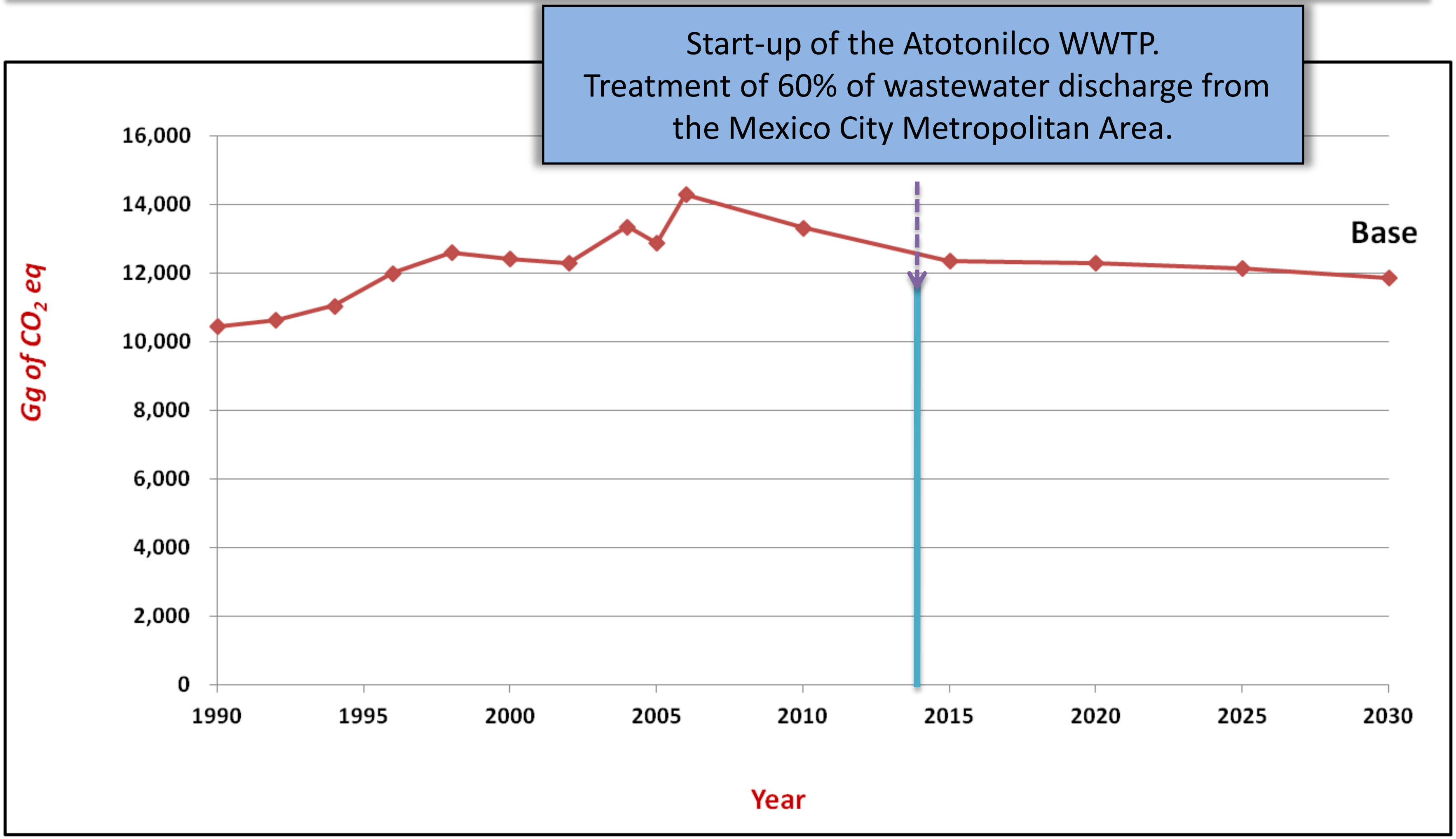
Methane emissions from municipal wastewater treatment facilities in Mexico

Time frame: 2012 - 2030

A base scenario was determined considering the present rate of WWTP construction and the technologies now adopted.

Five scenarios were developed and their corresponding GHG emissions estimated.

Base scenario for GHG emissions from municipal WWTP in Mexico



Note: the data for the 1990 – 2006 period are taken from INE, 2009

Five mitigation scenarios for municipal WWTP in Mexico

WA Mexican Water Agenda for 2030

- 100% of collected municipal wastewater is treated
- All these facilities comply with the NOM-001 (discharge standards)

WA1

- The same conditions for WA
- New WWTP based on aerobic processes:
  - •Activated sludge
  - •Aerated ponds
  - •Trickling filters
  - •Biological rotating contactors

Five mitigation scenarios for municipal WWTP in Mexico

WA2
(anaerobic + aerobic)

- The same conditions for WA
- New WWTP based on combined processes: Anaerobic reactor (UASB) followed by:
  - Activated sludge
  - Aerated ponds
  - Trickling filters
  - Biological rotating contactors
- Methane is burned in flares (84% of produced methane)

WA2z
("zero" methane emissions)

- The same conditions for WA2
- 100% of dissolved methane in the anaerobic effluent is collected and burned
- Burning efficiency 95%.

WA2e
(biogas for electricity generation)

- The same conditions for WA2
- 50% of dissolved methane in the anaerobic effluent is collected
- Biogas is used for electricity supply in the WWTP (facilities larger than 500 L/s)

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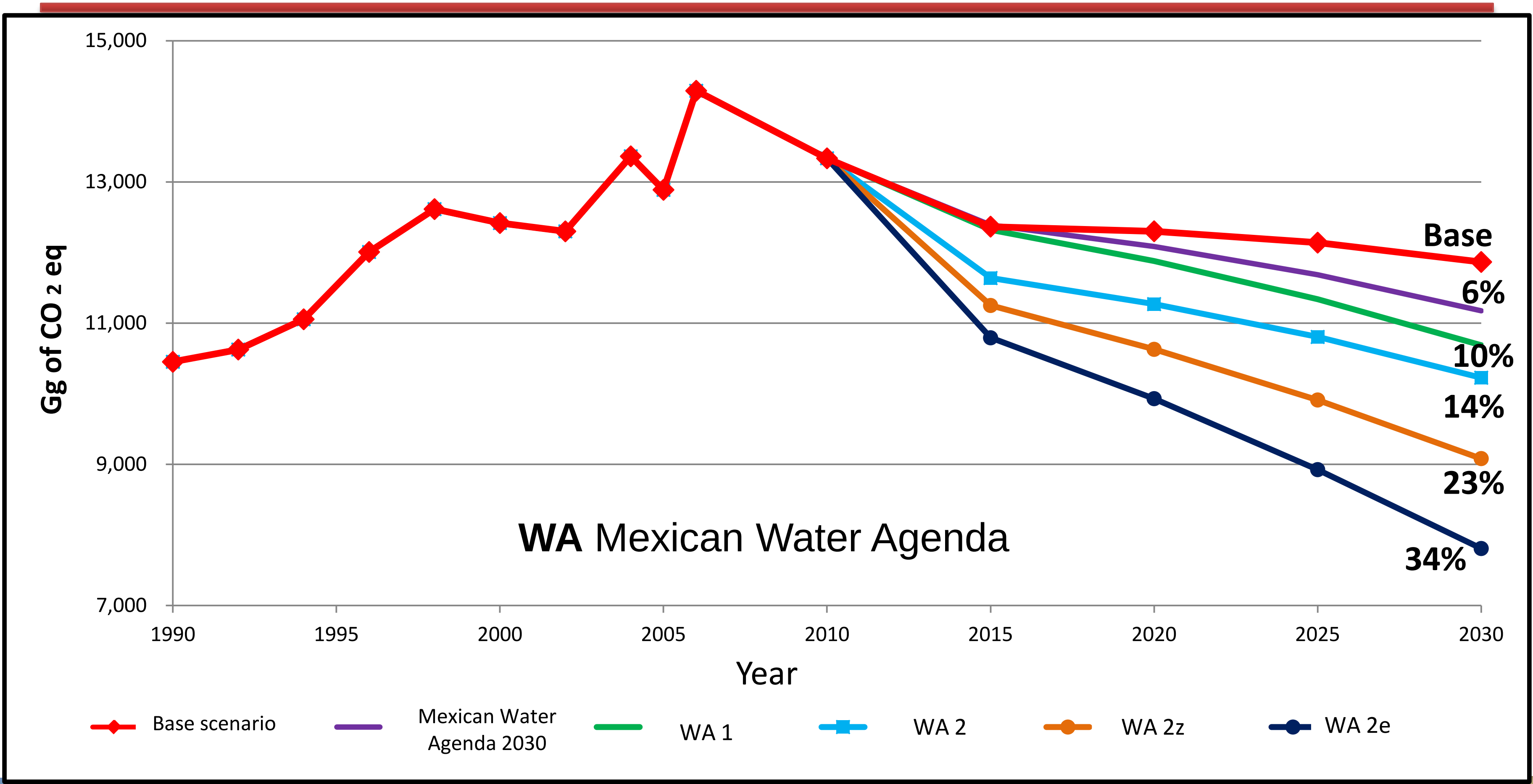
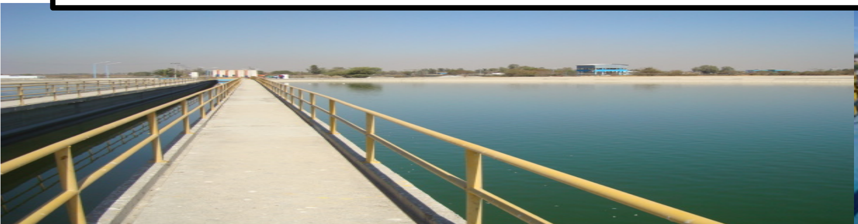
Comparison of five mitigation scenarios for municipal WWTP in Mexico





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Final remarks

- In Latin America and the Caribbean, stabilization ponds, activated sludge and UASB reactors are the most widely used wastewater treatment processes (80% of the facilities in the sample)

- However, activated sludge is responsible for 58% of the treated flow

- The anaerobic path is a sustainable option for the treatment and valorization of organic waste
  - Low energy consumption
  - Net energy production (source of renewable energy)
  - Nutrient conservation for agricultural purposes
  - Less GHG emission factors (when biogas is collected and used)
  - Limited carbon footprint



Final remarks

- The main disadvantage in anaerobic treatment is the methane fraction that leaves as dissolved gas and it is released to the atmosphere
- There is still a long way to go for the anaerobic option to be accepted for municipal sewage treatment
- The (post) Kyoto Protocol and the voluntary carbon markets can promote the acceptance of this technology

Final remarks

- Scenarios WA1 and WA2 allow a limited reduction of GHG emissions. However, they may be implemented in the short term.

- Scenario WAe is the most attractive one (34% emission reduction at 2030) but research and technology development is needed in order to collect the methane dissolved in the anaerobic effluent by simple means.



UASB at Brazil (MG): 2 m^3/s

UASB at Brazil (MG): 2 m^3/s

Post treatment with trickling filter in Brazil (MG): 2 m^3/s

UASB and trickling filter in Brazil (PR): 1 m^3/s

Muchas Gracias!

Thank you!