National Context in Mexico: Opportunities and Barriers

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Outline

- CH_4 and CO_2 in WWTP
- Mexican GHG inventory and NDC
- Municipal WWT coverage and biogas facilities
- Opportunities and barriers for increasing CH_4 production and recovery in municipal WWT facilities in Mexico
- Final remarks

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CH_4 and CO_2 in WWTP

• Wastewater treatment may produce methane depending on the chosen technology and how it is operated.

•Second most abundant GHG after CO_2 with a GWP of 28 (now 34 as IPCC, 2013)

•Methane produced from wastewater management accounts for between 8 to 11% of overall anthropogenic CH_4 emissions*

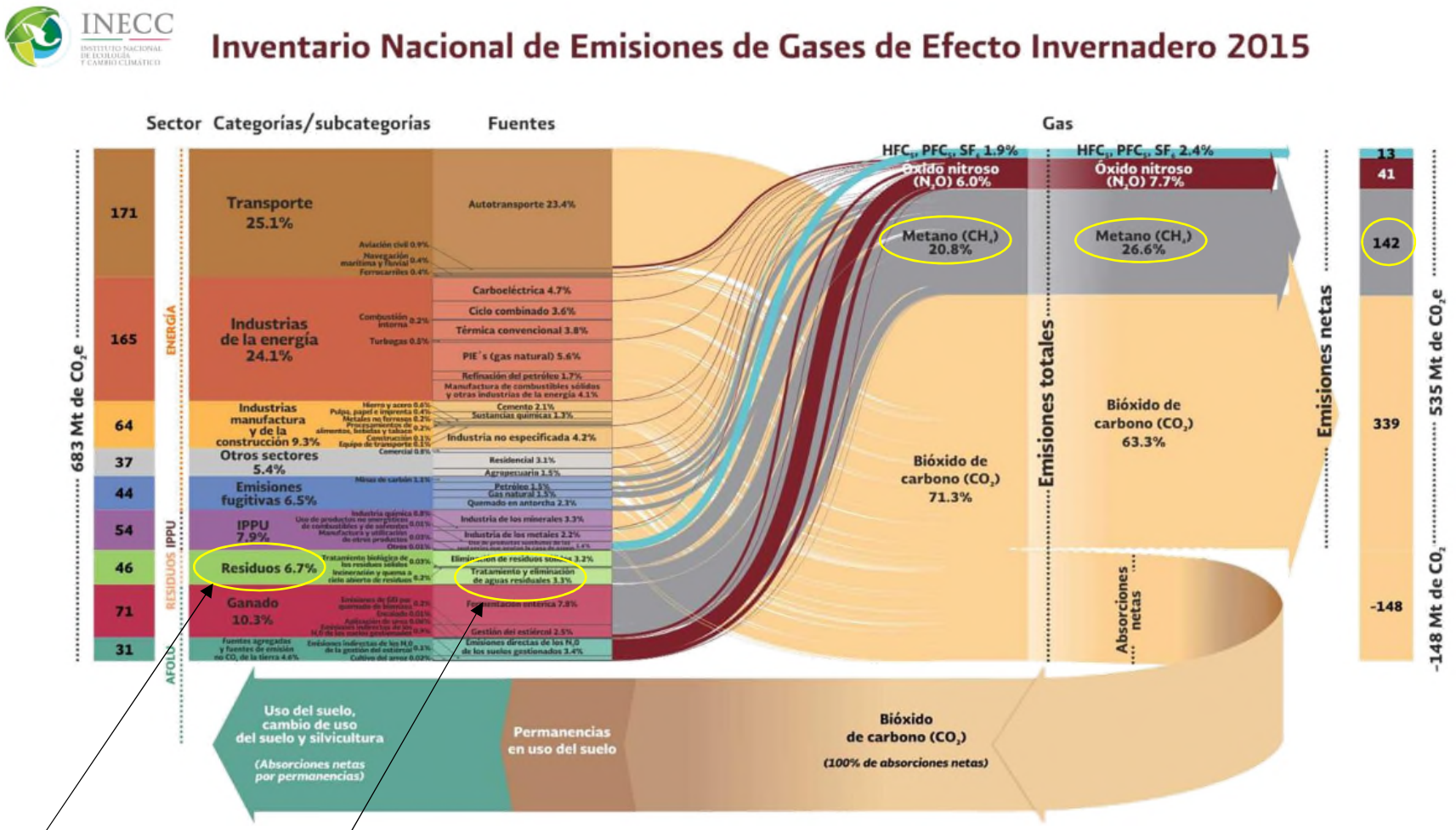
• Wastewater treatment facilities may be intensive in energy use, depending on chosen technology.

• Electricity requirements for wastewater treatment have an impact on CO_2 production at the generation facility (indirect emissions from fossil fuels).

• Energy efficiency, less energy demanding treatment processes or energy from waste (co-generation) schemes are the options for reducing indirect CO_2 emissions in WWT facilities.

* (Abdulla & Al-Ghazzawi, 2000)

Mexican GHG Inventory, 2015



Waste (6.7%), (30% on CH_4)

Wastewater treatment and discharge (3.3%), (14% on CH_4), (2.6% on CH_4 from municipal sewage)

INECC (2018)

https://www.gob.mx/inecc/documentos/investigaciones-2018-2013-en-materia-de-mitigacion-del-cambio-climatico

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National commitments on GHG emissions reduction

- *National Strategy on Climate Change, 10-20-40 years* (SEMARNAT, 2013)
  - To reduce GHG emissions up to 30% with respect to the business-as-usual (BAU) scenario by 2020
  - To reduce GHG emissions up to 50% with respect to the 2000 emissions levels by 2050

Up-date:

- *2016 NDC*: to reduce 25% of GHG and SLCP emissions (below BAU) for year 2030 (reduction of 22% of GHG and 51% of Black Carbon)

- Target for clean electricity generation (clean energies)

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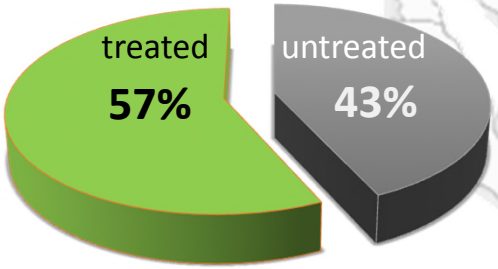
Sewage treatment coverage in Mexico

2477 Municipal WWT facilities

Municipal wastewater treatment in Mexico



Collected flow: 212 m^3/s

Treated flow: 120.9 m^3/s

Treated flow:

65% aerobic processes (Act. Sludge)

11% Facultative ponds

Industrial wastewater

Total: 214.6 m^3/s

Treated: 70.5 m^3/s (33%)

2832 WWT facilities

CONAGUA (2016)

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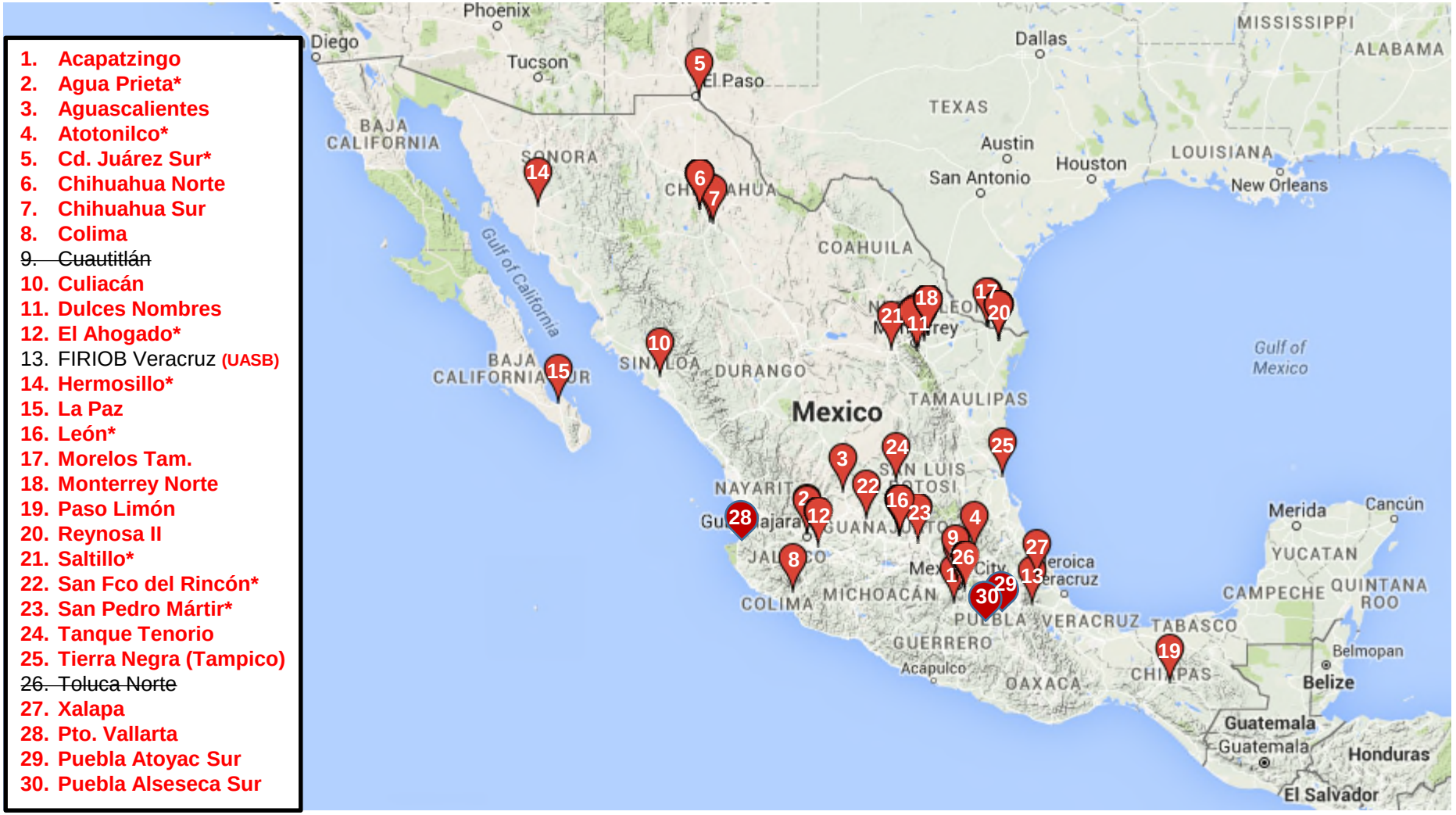
Municipal WWT facilities with anaerobic digesters

1. **Acapatzingo**
2. **Agua Prieta***
3. **Aguascalientes**
4. **Atotonilco***
5. **Cd. Juárez Sur***
6. **Chihuahua Norte**
7. **Chihuahua Sur**
8. **Colima**
9. ~~Cuautitlán~~
10. **Culiacán**
11. **Dulces Nombres**
12. **El Ahogado***
13. FIRIOB Veracruz **(UASB)**
14. **Hermosillo***
15. **La Paz**
16. **León***
17. **Morelos Tam.**
18. **Monterrey Norte**
19. **Paso Limón**
20. **Reynosa II**
21. **Saltillo***
22. **San Fco del Rincón***
23. **San Pedro Mártir***
24. **Tanque Tenorio**
25. **Tierra Negra (Tampico)**
26. ~~Toluca Norte~~
27. **Xalapa**
28. **Pto. Vallarta**
29. **Puebla Atoyac Sur**
30. **Puebla Alseseca Sur**

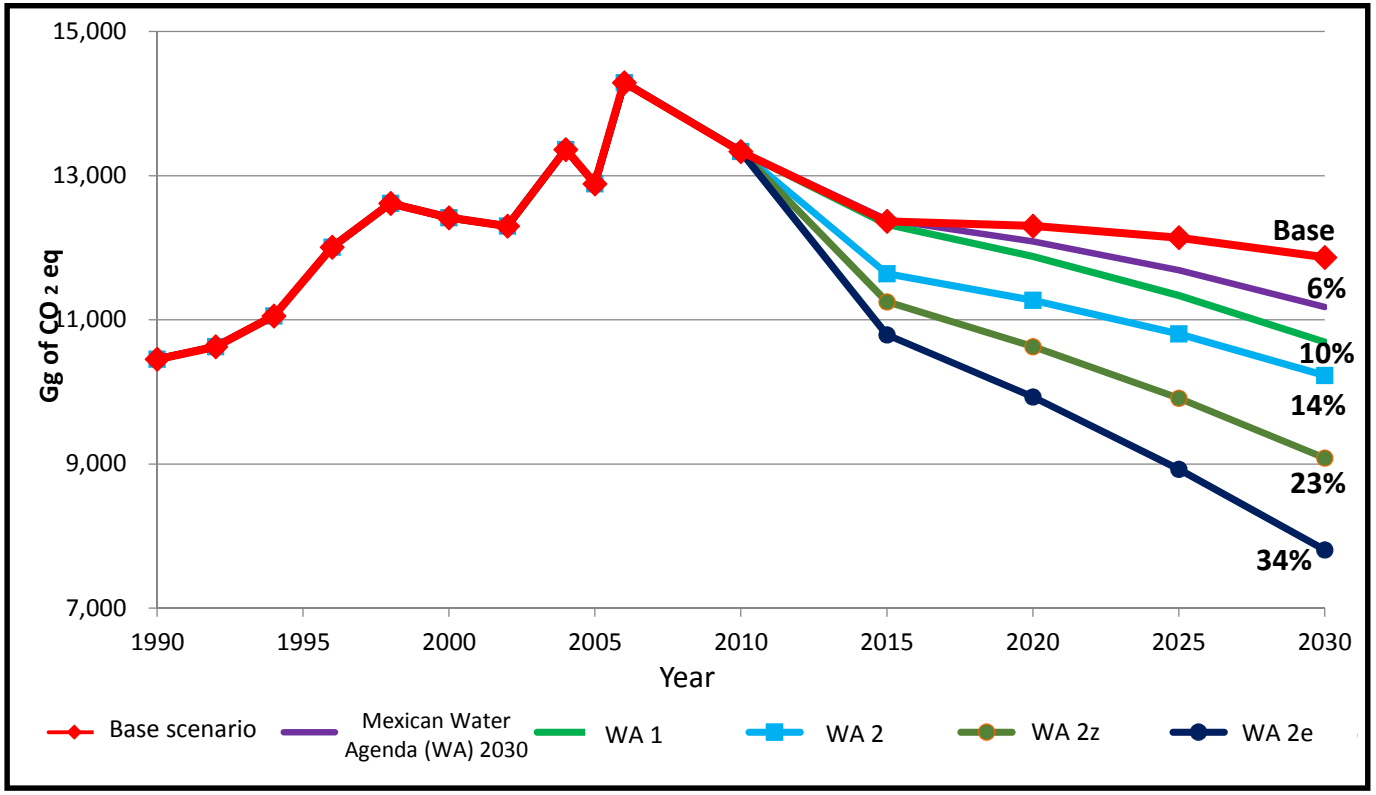


In red: WWTP with sludge anaerobic digesters
In black: Candidates to adopt sludge anaerobic digestión
* Biogas recovery for energy production (9)

Adapted from GIZ (2017) and IMTA (2017)

Comparison of five mitigation scenarios for municipal WWTP in Mexico

The role of technology selection



Noyola et al. (2016)

CLEAN
Soil Air Water

1091

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Research Article

Reduction of Greenhouse Gas Emissions From Municipal Wastewater Treatment in Mexico Based on Technology Selection

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Most attractive scenario (WA 2e)

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

  } All scenarios

  - 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 (76% of produced methane; 20% is dissolved in effluent)
  - 50% of dissolved methane in the anaerobic effluent is collected
  - Biogas is used for electricity production in WWT facilities larger than 500 L/s.

- Results
  - 34% lower CO_2e emissions if compared to BAU scenario
  - 25% lower CO_2e emissions if compared to the 1990 level.

Noyola et al. (2016)

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CH_4 mitigation approaches for WWT facilities

Optimize energy use in existing facilities (indirect CO2 emissions)

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Operational problems. The case of a WWTP in Mexico

Aerodyne Research Mobile Laboratory

Tracer ratio emission method

Quantum cascade laser instruments were used to monitor CH_4

gef

MCE2 Molina Center for Energy and the Environment

Installed capacity (l/s): 3000 Treated flow (l/s): 2300 Process: Activated sludge

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Results

- The theoretical CH_4 emissions should be zero (this is a fully aerobic system)
- Experimental measurements showed that actual CH_4 emissions from the WWTP were 0.464 Gg CH_4 /year.
- Emission factor of 6.4 g CH4 per m3 treated for this specific facility, corresponding to a 1.7% of the influent COD or 3.6% as BOD (4.2% BODrem).
- There are poor operating practices, related with deficient primary settler operation (sludge withdrawal).
- In addition, methane dissolved in the influent sewage should not be neglected.

Noyola et al. (submitted)

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Opportunities (*barriers*) for increasing CH_4 production and recovery in WWT facilities in Mexico

- National legislation (Climate Change and Energy Transition laws) provides solid bases
- The value chain of the biogas market should be supported by effective government actions
- *Create a financial fund to support biogas projects for clean energy production*
- *Develop and enforce regulations (NOMs) for biogas management and utilization*
- *Improve the collaboration of SENER and SEMARNAT (CONAGUA) to achieve synergies*
- *Equipment manufactures, process engineers, construction and commissioning companies should identify a real business environment*
- *Capacity building (designers, constructors and operators) should be provided by a formal system*

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Final remarks

- Methane issues in Mexico are moving in the right direction, but slowly
- A methane market should be developed with good levels of certainty
- In the WWT subsector, lacking infrastructure is a major opportunity for aligning Mexico's climate change and energy transition targets.
- Improve the GHG-performance of existing WWT infrastructure by ensuring good operation practices.
- Provide financing alternatives for developing (manufactures) and installing (operators) co-generation systems from biogas in small and medium size facilities
- *Improve the collaboration of SENER and SEMARNAT (CONAGUA) to achieve synergies*

- A technical guide for design engineers and operators of biogas facilities.
- First comprehensive, technical document in Mexico

https://www.gob.mx/sener/documentos/guia-tecnica-para-el-manejo-y-aprovechamiento-de-biogas-en-plantas-de-tratamiento-de-aguas-residuales

Thank you