Workshop for an Initiative on Renewable Energy and Climate Change for the Americas: Metrology and Technology Challenges

Jorge Koelliker D., CENAM

Climate Change and Renewable Energy in Mexico

CONTENT

1. Most important issues for Mexico?
2. Regulatory framework?
3. Strengths of the country?
4. Needs short and long terms?
5. Opportunities of collaboration?

1.a Most important issues in climate change for Mexico?

- **Significant air pollutants in atmospheric monitoring (emissions and inmissions)**
  Development of Chemical measurement standards in Mexico

  - Greenhouse gases (GHGs): main in amount, significant contributor. ***Kyoto Protocol***
    - **CO_2**, **CH_4**, **O_3**, **N_2O**, **SF_6**, originally chlorofluorocarbons (CFCs), replaced by hydrochlorofluorocarbons (HCFCs), now replaced by the latest hydroflurocarbons (**HFCs**), **NF_3**

  - Short-Lived Climate Forcers or Pollutants (SLCFs / SLCPs) for near-term climate protection: **CH_4**, **tropospheric O_3**, **black carbon**, short-lived hydroflourocarbons (HFCs).
    - HFCs are a type of fluorinated greenhouse gas intentionally made as replacements for stratospheric ozone depleting substances (ODS, ***Montreal Protocol***), for use in the same applications (air conditioning, refrigeration, solvents, foam blowing and aerosols)

  - Criteria air pollutans (gases) for ambient air (inmissions):
    - Pb, CO, **O_3**, NO_2, **$PM_{10,\ 2,5}$** … 1.0 …, SO_2, VOCs, H_2S (not a criteria air pollutant, but at ambient levels)

  - Stack and mobile emissions
    - Metals (Pb, Hg, …), hydrocarbons (HCs expressed as C_3H_8 or bencene) CO, CO_2, NO_x, $PM_{10,\ 2,5\ \ldots\ 1.0\ \ldots}$, SO_2, VOCs, …

  - Persistant Organic Pollutants (POPs). ***Stockolm Convention***. Dioxins, Pesticides, PCBs.

  - PAHs (carcinogenic – mutagenic).

Bolded and shadowed = Priorities detected by environmental autorities, Red = not worked , Blue = not worked but feasible to work with, Green = worked or in process to be done, Gray = lower demand, not worked, Pink = Significant in some sectors, but not being metrologically worked in CENAM, Purple = Some work done, but in other matrices, not for air applications

1.a Most important issues in climate change for Mexico?

Why Greenhouse gases and air pollutants together?

"A gaseous atmosphere is maintaining our life"

- **Significant**: *understanding chemistry and physics of the atmosphere*

  - Primary and secondary air pollutants and their precursors or (sub)products are sometimes all relevant pollutants in climate change (e. g. O_3: CH_4, VOCs, NOx, etc.; CO_2: CO, CH_4, carbon cycle; nitrogen cycle; acid rain: SOx, NOx)…

  - Substances and radicals that induce reactions or the presence or other air pollutants (CHCO, OH, PANs, etc.). Some of them are inestable, thus not prone to have them as measurement standards.

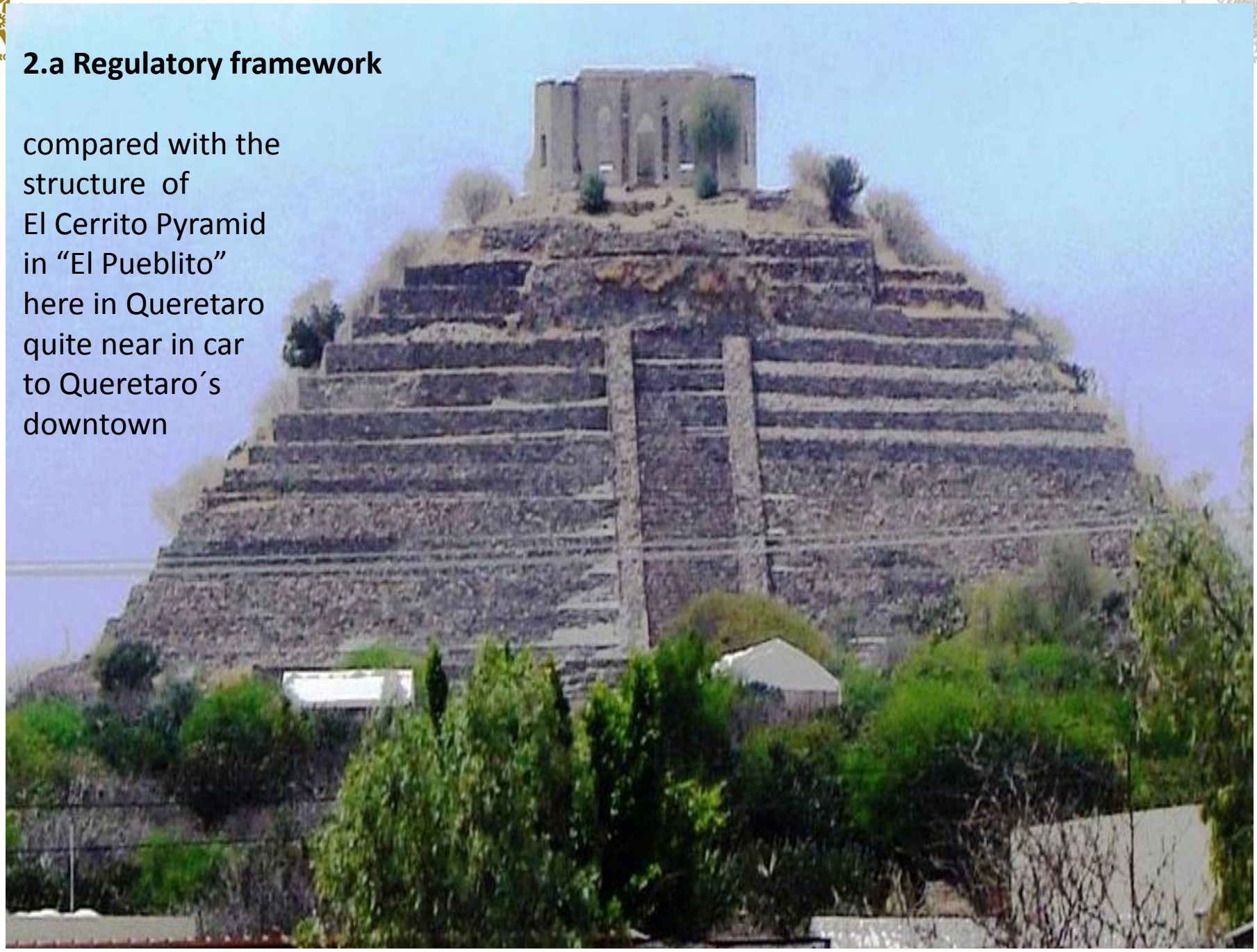
1.b How issues/technologies for renewable energy and climate science impact economic development in Mexico and NORAMET ?

1.c Are there other driving forces for renewable energy and climate science?

- More new green business and employments
- In Mexico, cost of Environmental Degradation and their Economic Loss was 6.9 % of GDP (PIB) in 2011 (INEGI), approx. 60 Million USD / year (NDP).
- Any direct answer, transdisciplinary work, orientation and collaboration with different Ministries and neighbor countries is needed. There are some studies available for that in Mexico and our north neighbors, but they are not yet being fully searched by us in CENAM.
- Ministries and Institutions need to bring their metrological needs to CENAM in order to find common solutions and collaboration.
- CENAM needs resources assigned by our Mexican Congress and/or Sectorial or Special Programs to attend metrological needs in climate science and renewable energy in more integrated ways, if not we could only attend isolated efforts.

2.a Regulatory framework

compared with the structure of El Cerrito Pyramid in “El Pueblito” here in Queretaro quite near in car to Queretaro´s downtown



CENAM
CENTRO NACIONAL DE METROLOGÍA

Mexico is a no Annex I country of the UNFCCC
13th rank as country in GHGs global emissions (2 % of GHGs)

United Nations Framewok Convention on Climate Change

National Communication to the UNFCCC (Fifth -2012)

Emission inventories methods (top - down)

Intergovernmental Panel on Climate Change (IPCC)

Reduce emissions of GHGs in 30 % by 2020 (50 % 2050) baseline 2000

Emission factors and Activity factors

Kyoto protocol

2.a Regulatory climate / situation in Mexico (Climate Change)

General Law on Climate Change
In effect at (2013-08)

Statement of the General Law on Climate Change

National Development Plan 2013 - 2018

Federal funds

Environmental Sector Program

Special Program on Climate Change

Specific projects and actions supported by funds

National Strategy on Climate Change Vision 10-20-40 (years)
In effect (2013-06-04)

State and Municipal Programs on Climate Change
(basically inventories of GHGs and actions to mitigate/adaptate)

Programs in CENAM in line with current regulations, strategies and governmental programs and also focused in future needs

Policies

Climate science, mitigation and adaptation to CC

Actions (for Sustainable Development)

Technology

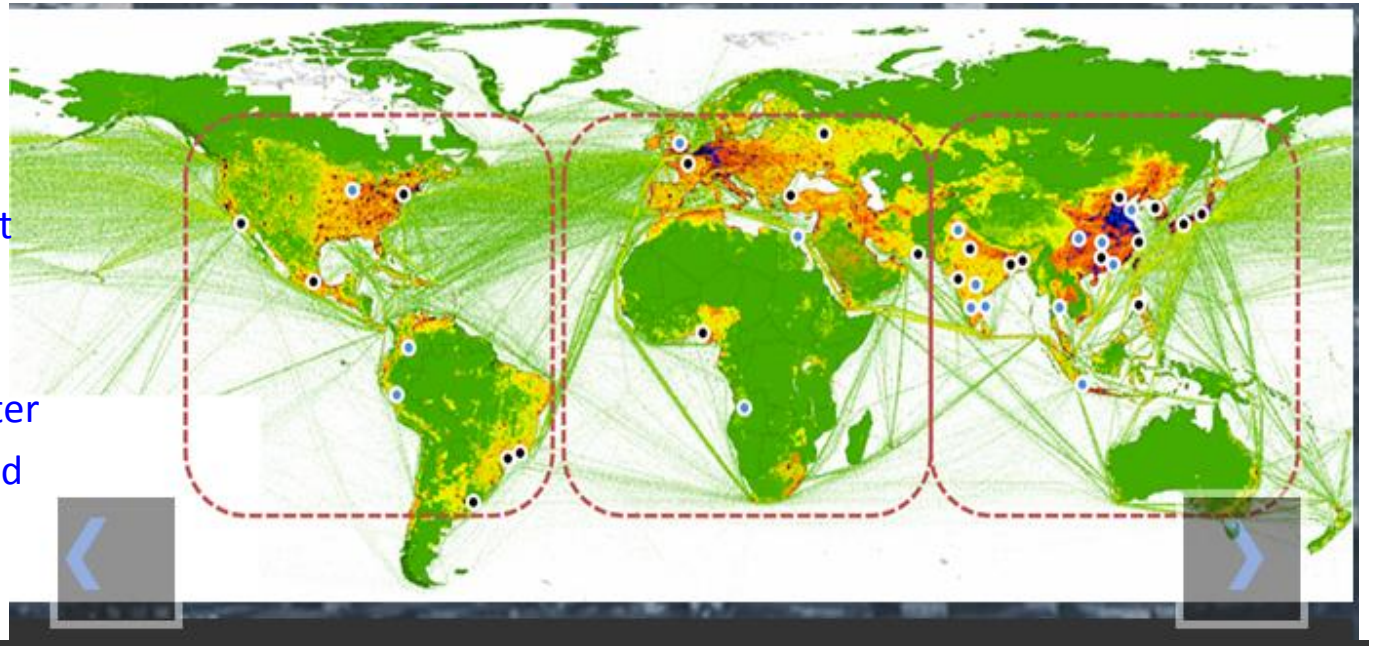
In development or changing every federal government

- **Mitigation**
  - National policy of mitigation should include: diagnostic (national and sectorial baseline), plan, measurement, monitoring, report, verification and evaluation of national emissions.
  - Arrangements at federal, state and municipal level to reduce emissions at specific sectors and activities through actions and programs.
  - International treaties signed by Mexico to be considered.
  - Low-emission development strategies (LEDS)
  - Green Economy
  - Nationally Apropriate Mitigation Activities (NAMAs)
  - Mexico is a member of the Global Green Growth Institute since 2012
  - Mexico is a founding member of Climate and Clean Air Coalition (CCAC) to Reduce Short-Lived Climate Pollutants

Submitted project to BMZ (Germany): Quality infrastructure for traceable measurements of greenhouse gases (GHGs) to support their report, measurement and verification strategies“

- Case of 40 Megacities: 3rd contributor to GHGs after USA and China

This Megacities Project is for GHGs and not the same as that with the participation of the Molina Center (mcE^2) presented By Dr. Guzman from IMP



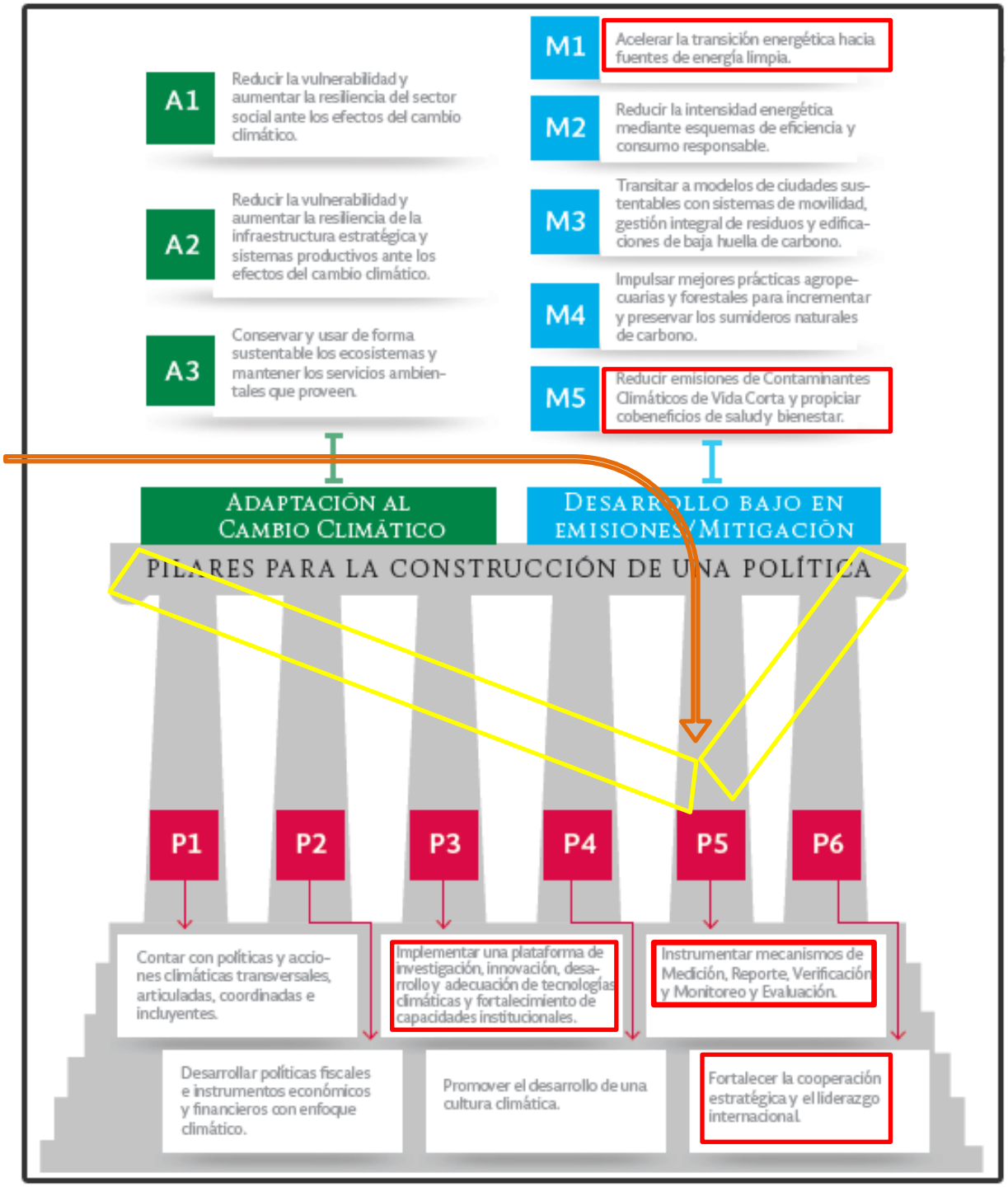
Cities: responsible for 70% of fossil-fuel CO2 emissions
A 10-km-resolution map indicates the distribution and intensity of fossil fuel CO2 emission sources. The regions with greatest emission intensity are indicated by red and black (urbanized areas and associated large power plants). The black circles indicate a vision for future surface measurement networks concentrated within the 23 existing megacities. Blue circles indicate the 14 additional megacities projected to exist by 2025. The dashed rectangles indicate the fields of regard of three remote-sensing instruments that if hosted on geostationary satellites would offer sustained, wall-to-wall mapping of nearly every emission source. The satellite and surface network data, integrated with improved high-resolution emission estimates would provide a robust system for assessing and informing policies. Map: (EDGAR version 4.0) 2009.

CENAM
CENTRO NACIONAL DE METROLOGÍA

National Strategy on Climate Change Vision 10-20-40 (years) 2013

Without Metrology

Mexican goverment / environmental authorities gave money to the mcE2 to **decrease uncertainty in GHGs emission factors** for **Mexican inventories**, but **it is not supported by Metrology**. I confirmed the lack of understanding of that topic with Luisa Molina. She wants to talk with us. NIST / CENAM /NMIs could cooperate with them



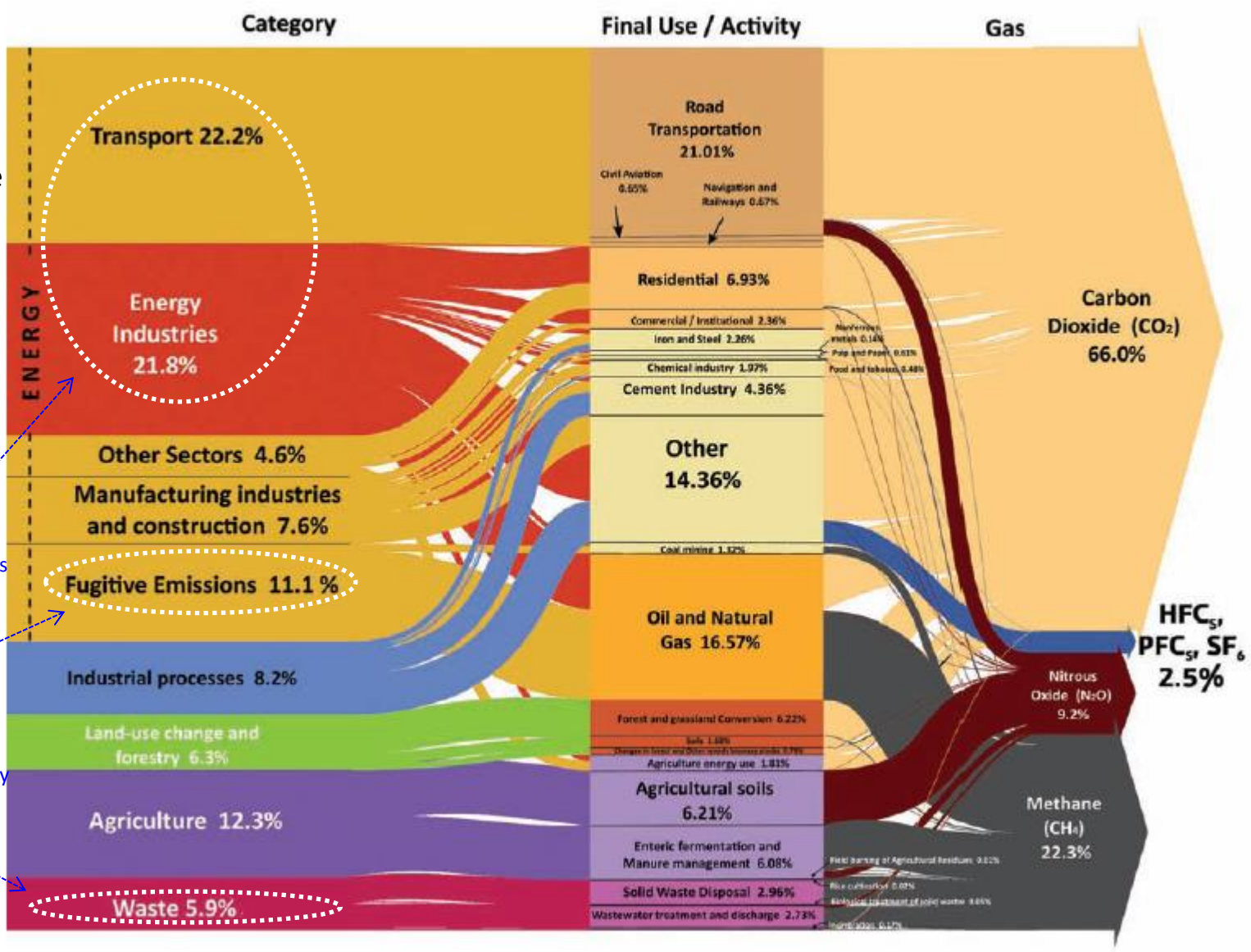
Fifth National Communication to the UNFCCC (for 2010, reported 2012) - Mexico

Great <u>opportunities to reduce</u> and make a difference measuring and verifying changes with help of <u>Metrology</u> for new services with own technical needs, e. g.

Change in energy sources and fuels:

Measure/verify fugitive Emissions

Take advantage of energy in organic wastes



748 $MtCO_2$ eq.

„Quality infrastructure for traceable measurements of greenhouse gases (GHG) to support their report, measurement and verification strategies“

Some remarks

- CENAM has 16 years **experience on emission services**: vehicle and stack emissions, **participation** in some **CCQM-Key Comparisons and Pilot Studies** of GHGs and Air Pollutants. It is the only Iberoamerican NMI with **core capabilities in gases published** today (it does not include some GHGs, GHG chemical measurement standards are challenging, not core!). As member of the CCQM we have regular participation in the GAWG and we are **following comparisons and knowlegde in GHGs and air quality measurements**, in particular more interest of CENAM in GHGs starts with the presentation of NIST in the 10th anniversary of the CIPM (2009) and with the Workshop on GHG organized in USA by NIST (2010).

    - **Steps of Development in Gas Metrology: please first binary gas mixtures high concentrations, i.e. emissions, lower concentration and multicomponent gas mixtures are challenging: so truly air quality levels (not their premixtures) are very challenging!, i. e. inmissions are more difficult!**

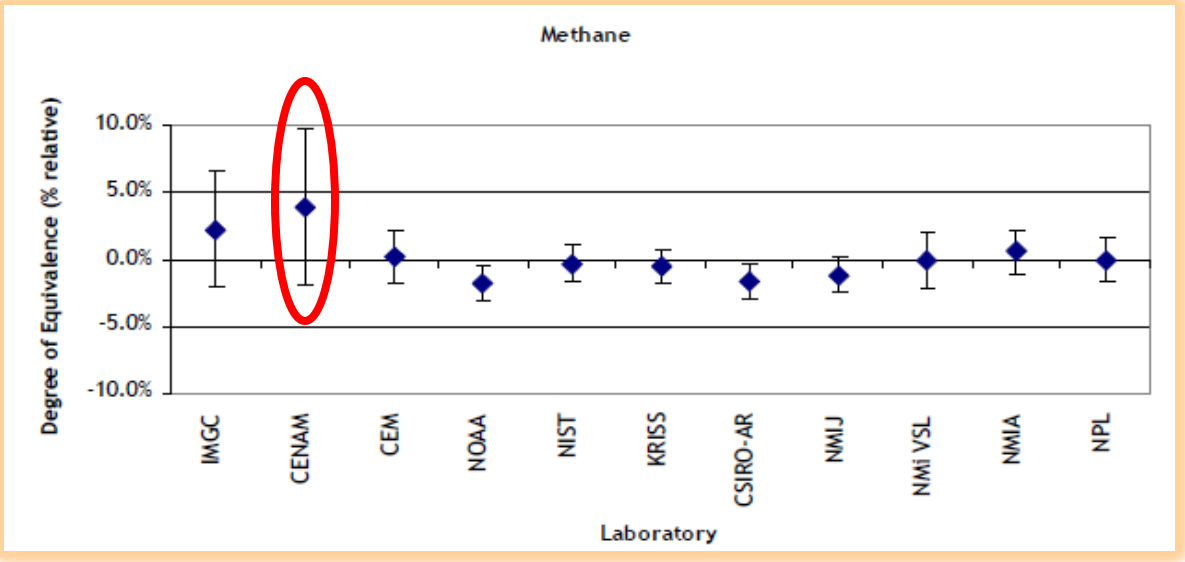
- Politically, **Mexico** has been very involved in **climate change initiatives**. In my knowledge, Mexico is the 2nd country in the World with a General Law of Climate Change (2012, first was UK), having a new National Institute of Ecology and Climate Change. First country reporting to the UNFCCC inventories on Short Live Climate Forces (SLCF, 2012).

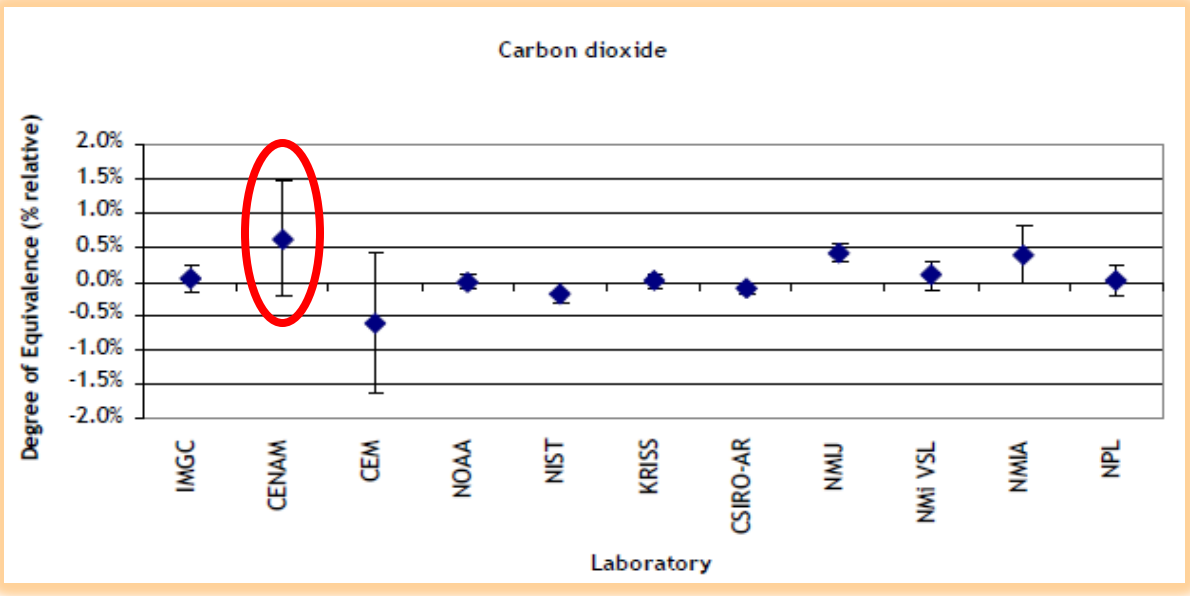
„Quality infrastructure for traceable measurements of greenhouse gases (GHG) to support their report, measurement and verification strategies“

More **remarks**

- Many scientist doing an excellent job in monitoring the air, but only a few truly understand and apply Metrological Traceablity and Metrology in Chemistry Capabilities, so more guidelines are required
  - **Not only for gas analysis in gas phase, but also for wet methods. Examples:**
  - **In spectroscopic measurements doing "absolute measurements" linestrengths have many times very high uncertainties and no traceability, there are signifcant uncertainty sources, e. g. for QCLs, CRDS, etc.**
  - **Wet methods also need good metrological practices, e. g. measuring vertical profiles of O_3 in planes or globes absorbed in KI.**
- Willie May invited Mexico to the Megacities project (Oct 2012), projects also done in the globe with already available infraestructures

CCQM-P41 Greenhouse gases – CO_2 and CH_4 in Air (2003)





Example of CRMs and DQO of WMO

Projected Typical Certified Values for SRM 1720 : Northern Hemisphere Greenhouse Gases

	NIST Concentration[a]	NOAA Concentration[a]	WMO Data Quality Objective[b]
CO_2	393. 30 ± 0.10 µmol/mol	393.38 ± 0.20 µmol/mol	± 0.1 µmol/mol
CH_4	1878.1 ± 1.0 nmol/mol	1875.9 ± 1.5 nmol/mol	± 2 nmol/mol
N_2O	323.04 ± 0.20 nmol/mol	323.10 ± 1.0 nmol/mol	± 0.1 nmol/mol
CO	≈ 160 ± 4 nmol/mol (vary 35 % sample to sample)	No NOAA Data	± 2 nmol/mol
SF_6	≈ 7 ± 0.04 pmol/mol	7.16 ± 0.04 pmol/mol	± 0.02 pmol/mol

[a] Expanded uncertainty at k=2 coverage factor, 95 % confidence interval.
[b] Standard uncertainty at 1 σ (k=1 coverage factor).

Some studies available for Renewable Energies to answer, at least partially, the many questions asked by coordinators of the Workshop.
Go to our Ministries of Energy and Agriculture:

http://www.sener.gob.mx/portal/energias_renovables.html

http://www.bioenergeticos.gob.mx

2.a Regulatory climate / situation in Mexico (Renewable Energy)

United Nation Framewok Convention on Climate Change

Intergovernmental Panel on Climate Change

Kyoto protocol

Law of Promotion and Development of Bioenergetics In effect at (2013-08)

Rules of LPDB

National Development Plan 2013 - 2018

Federal funds

Energy Sector programme

Concurrent Special Programme for Rural Sustainable Development

Specific projects and actions supported by funds

National Energy Strategy 2013 - 2027

Energetic Reform in Mexico

Policies and programmes

Diversification of Energy sources, reduction of GHGs and pollutant emissions to the atmosphere

Actions (for Sustainable Development)

Sustainable technology

Programmes in CENAM in line with current regulations, strategies and governmental programmes and focused also in future needs

In development or changing every federal government

2b. How Mexican regulatory framework impact metrology needs for renewable energy and climate science?

- **General Law on Climate Change and its derivative regulations**
  - **Reports of GHGs not yet based at all on Measurements, neither in IPCC methodologies nor in the National Policies, not even in CEMs for Industries. To be expected MRV based on Metrology Principles at least in some emission sectors and in inmissions.**
  - **Increase to 35 % the use of *Clean Energy Sources* by 2024.**
  - **By 2018 Municipalities with population > 50 000 Inhabitants will avoid CH_4 emissions of solid wastes, if feasible technology to produce electrical energy (biogas). Commerce of *Biogas* requires Metrology!**

- **National Plan of Development**
  - **Renewable energies no more than 2 % of contribution to electricity. Promote efficiency of energy and advantages of Renewable Energy adopting new technologies. Reinforce Science and Technology for the Energy Sector. Include promotion of international cooperation in Energy Sector.**

2c. How Mexican regulatory framework impact the work for CENAM and NMIs in NORAMET?

- **Redirection of Goals: Development of measurement standards for GHGs and support to other climate magnitudes involved.**
- **Integral work in Mexico, and cooperate closer with Environmental Authorities but also with the National Meteorological Service (SMN) and Organizations (State or Municipal levels) in charge of Meteorological Stations.**
- **Development of traceable and reference methods for assays of GHGs.**
- **Transfer of knowledge, experiences and technologies from most advances NMIs, e. g. NIST: GHGs, NRC: black carbon & particles, INMETRO…. : biodiesel, ….**
- **Set of governmental priorities is clear, but in Metrology very delayed: SLCF and particles.**

3. Strengths of Mexico that would help meet the measurements and standard challenges in renewable energy and climate science?

- **Technology**
  - Participation of Mexico in more than 90 agreements and international protocols in the Environmental Agenda (PND, 2013)
- **Infrastructure**
  - Some, but still very limited. Bring to the discussion, the development of Central Facilities!
- **Natural resources**
  - Very rich and diversity of climates to promote the use of different renewable energies, but very sensitive to climate change
- **National commitment**
  - Clear commitment, but set of priorities could change every new federal government. Traditional political leadership of Mexican government in climate change issues
  - Action of the government to contribute to improve air quality and to reduce emissions of greenhouse compounds (NDP, 2013) E. g. Stablishment of the **Environmental Comision of Megalopolis (CAM) integrated by 6 States: D.F. and States of Mexico, Hidalgo, Puebla, Tlaxcala and Morelos. Before Metropolitan Environmental Comision (CAM) integrated only by DF and State of Mexico, with the goal of assure better environmental conditions of the inhabitants of this region (almost 30 million people).**

4. Short and long terms needs of Mexico for capacity development to meet these challenges in renewable energy and climate science?

- **Short term**
  - **SLCF, particles, main 3 GHGs in contribution, and use of clean renewable energy**
  - **Transfer of standards and measurement standards for climate change**
  - **Develop and apply knowledge in the Megacity: Mexico City.**
- **Long term**
  - **Contribute with traceable results in inventory guidelines of the IPCC and MRV of mitigation actions and NAMAs and initiate Metrology Support to the inventory reports for the UNFCCC.**

4a. How these short and long terms needs of Mexico for capacity development impact the work of CENAM and NORAMET?

- **Focus of resources in existent or new capabilities for Climate change and Renewable Energy Communities, for instance: GHGs, SLCF, and reinforce climate magnitudes.**

- **Providing traceability for GHG emissions, but also GHG at ambient levels (e. g. Megacities project) and with help of metrology give certainty to measurement and verification of mitigation projects of GHGs.**

- **Cooperation of NMIs with scientific and political representatives in the IPCC and also in the UNFCCC in our country. At least three identified in UNAM (one of them moved to INECC).**

5. Opportunities for regional and perhaps hemispheric collaboration in these areas

- **Hemispheric**
  - **International work on monitoring the atmosphere, well under way collaboration between consolidated NMIs and WMO-CCLs. However more measurement points with good metrology quality needed, for example being integrated in the GAW program of the WMO, own national resources needed. Countries with Megacities and National, Sub-national or Local Meteorological Organizations need collaboration.**

- **Regional**
  - **We, some of the NMIs, need closer and stronger cooperation with Environmental and Energy Ministries in our own country, and NMIs within the Americas.**
  - **Our measurement experts not only need to learn to measure well, but fully understand these (inter)national needs. Opportunities to develop Metrology Experts in the Regions to attend and disseminate knowledge in these topics should be promoted, so meetings, seminars and trainings will be expected.**


Thank you
jkoellik@cenam.mx