

Long Term Generation Planning; A Sensitivity Analysis to Promote Alternative Renewable Energies (“Wind”). Mexico Case Study; Use of Message Model

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**23rd IAEE North American Conference
October 20, 2003**



MESSAGE Model

- MESSAGE (**M**odel for **E**nergy **S**upply **S**trategy **A**lternatives and their **G**eneral **E**nvironmental **I**mpact).
- Formulates and evaluates alternative energy supply strategies consonant with user-defined constraints such as limits on new investment, fuel availability and trade, environmental regulations and market penetration rates for new technologies.
- By default, minimization of the total system costs is the criterion used for optimization of the MESSAGE model.
- Most Powerful feature of MESSAGE is modeling of relationships between technologies or between technologies and resources.



MESSAGE Model (cont.)

- Provides a flexible framework to define various types of relationships such as:
 - **Limit on a technology in relation to others (e.g., min. share of wind energy in total electricity generation).**
 - **A common limit to be met by a set of technologies (e.g., max. Limit on emission of SO₂ from all technologies).**
 - **Constraints between production and installed capacity (e.g., ensure take or pay clauses in international gas contracts forcing customers to consume a min. Share of the contracted level during summer months).**



MESSAGE Model (cont.)

- MESSAGE Software consists of the next components:
 - A User Interface for building a model
 - Databases
 - A matrix generation program called mxg
 - A optimization program called opt.
 - A program for the post processing of the solution for extraction of results called cap.

Cases Studies

1) Business as Usual Scenario

2) Market Penetration of Renewable Technologies

- **National Policy:** Promote Installation of Alternative Renewable Energies (“Wind”)
- **Goal:** At least 1000 MW installed by 2006.
- **Strategy:** Subsidize Investment & Tariff Costs (“Green Funds”)

3) Environmental Restrictions

(Use of Cleaner Technologies & Fuels)

- **National Policy:** Reduce Emissions of Acid Rain Gases and TSP in the Power Sector
- **Goal:** 50% Reduction in total SO₂ emissions; 10 fold reduction of NO_x emissions in new Gas CCP
- **Strategy:** Update of NOM-ECOL 085 (Emission Limits) & NOM-ECOL-086 (Fuels Quality)

Mexico Power Sector

Technology	Investement (\$00/kW)	Fixed Costs (\$/kW/year)	Var Costs (\$/kWyear)	P.F.	Eff	Constr. (year)	Life (year)
NPP	1500	42	35	0,69	0,35	5	40
GasCC	561	21,5	118,4	0,8	0,5	3	30
CoalPP	1328	31,6	67	0,75	0,34	4	30
OilPP	741	16,9	78,6	0,65	0,32	3	30
Hydro	2000	5,1	0,13	0,3	1	5	50
Wind	1100	19,1	8,2	0,3	1	1,2	30
Geo	1340	35,6	149,3	0,65	1	2	30

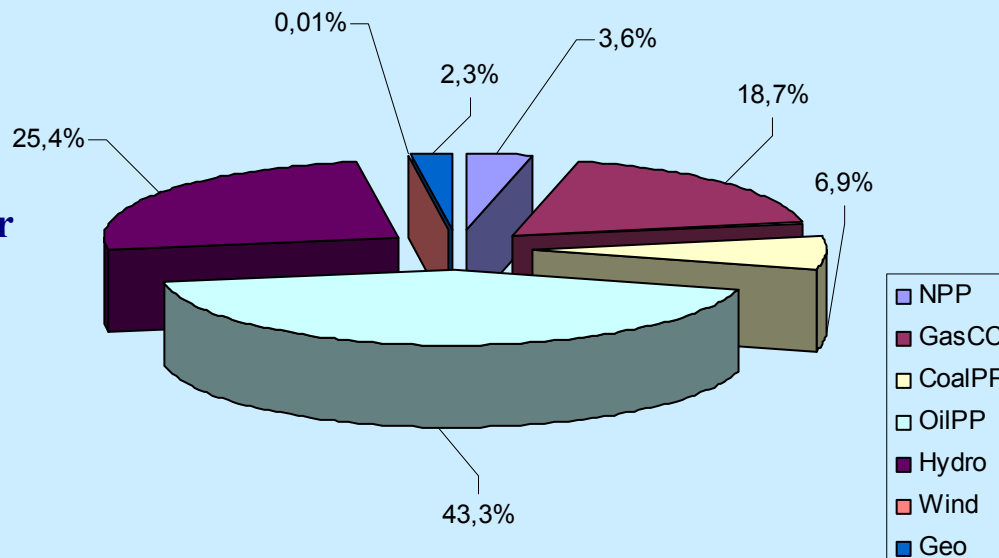
Installed Capacity (2000): 37913 MW

Electricity Demand (2000): 16556 MWyr

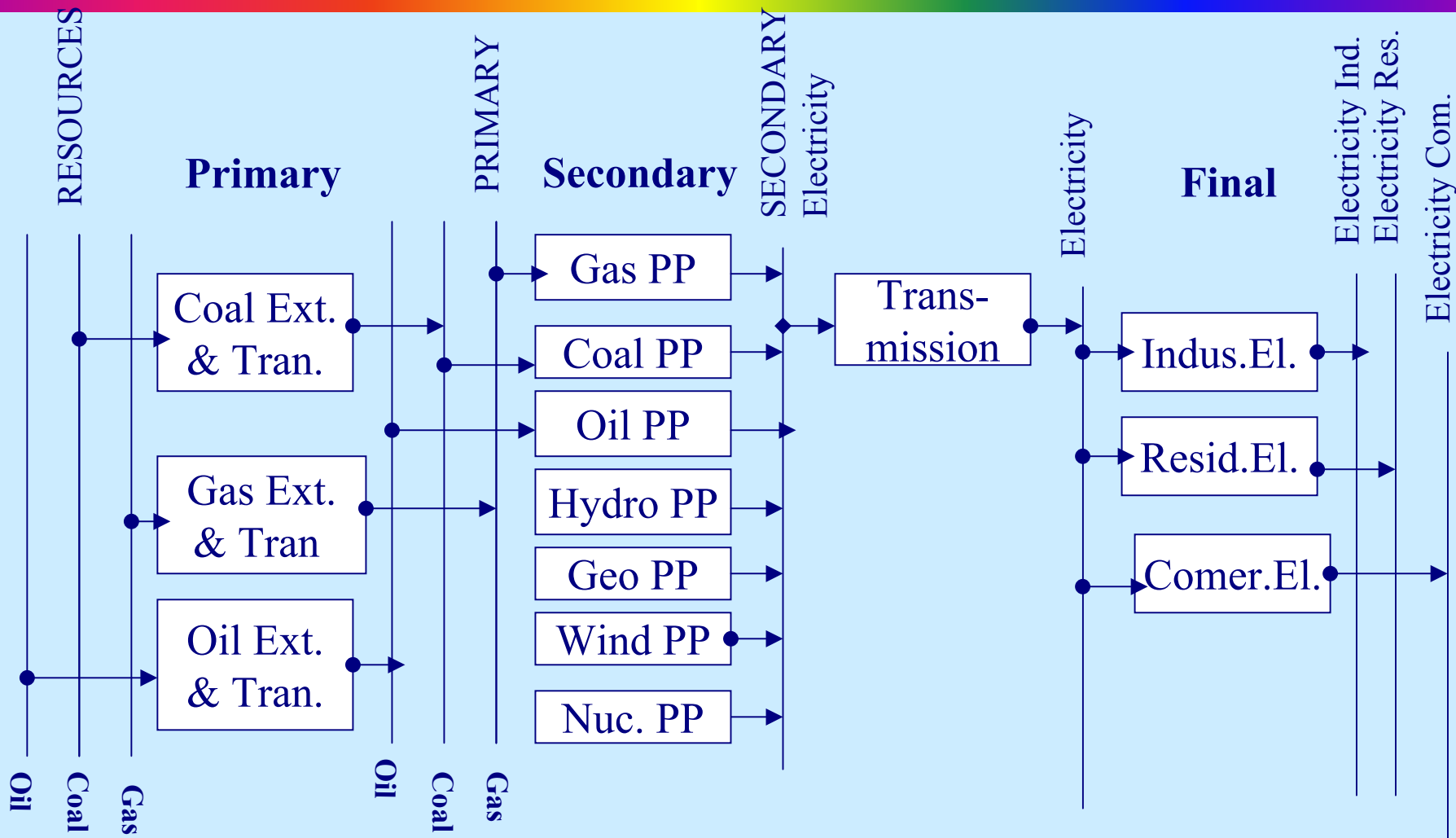
Annual Growth Demand: 5,5%

Discount rate: 10%

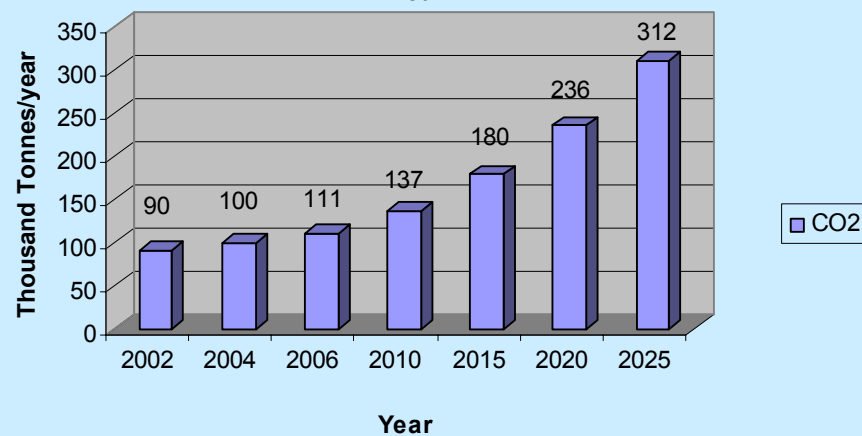
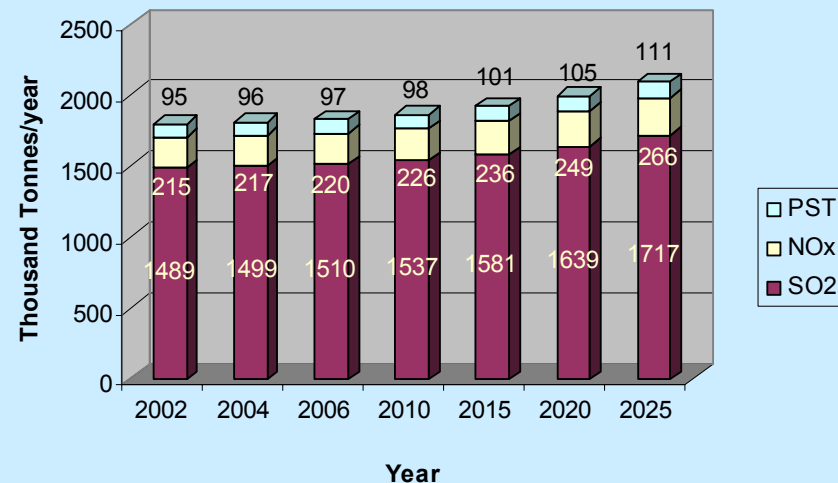
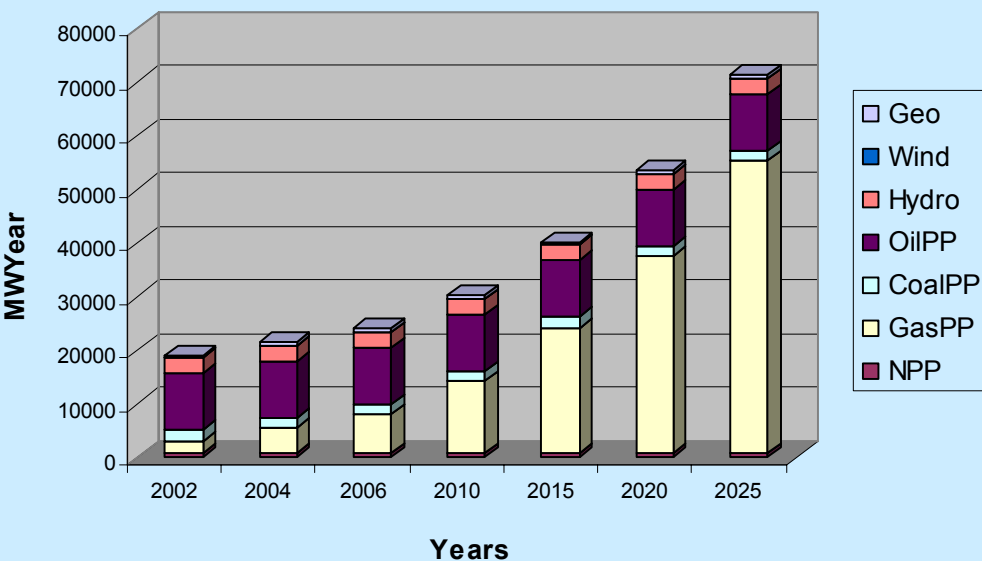
Study period: 2000-2025



Mexico Electricity System (Energy Chains)

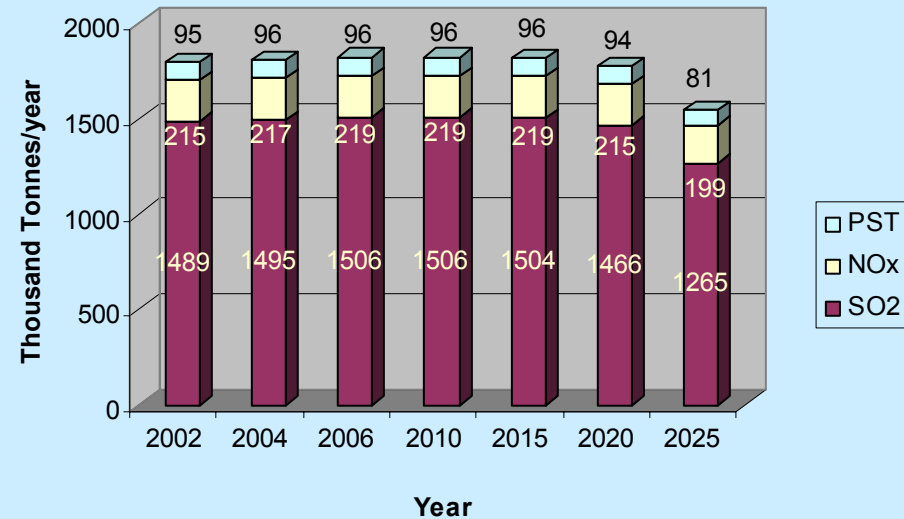
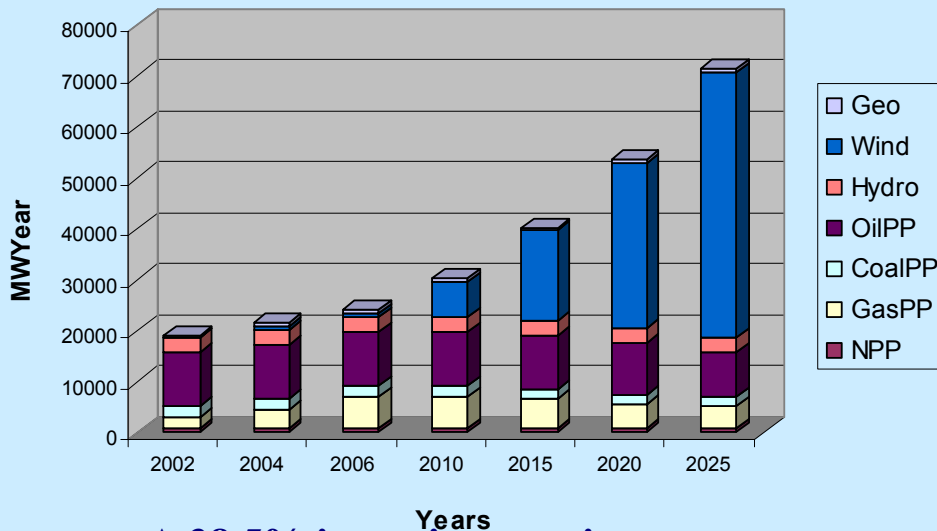


1) Energy Supply and Emissions (Base Case)



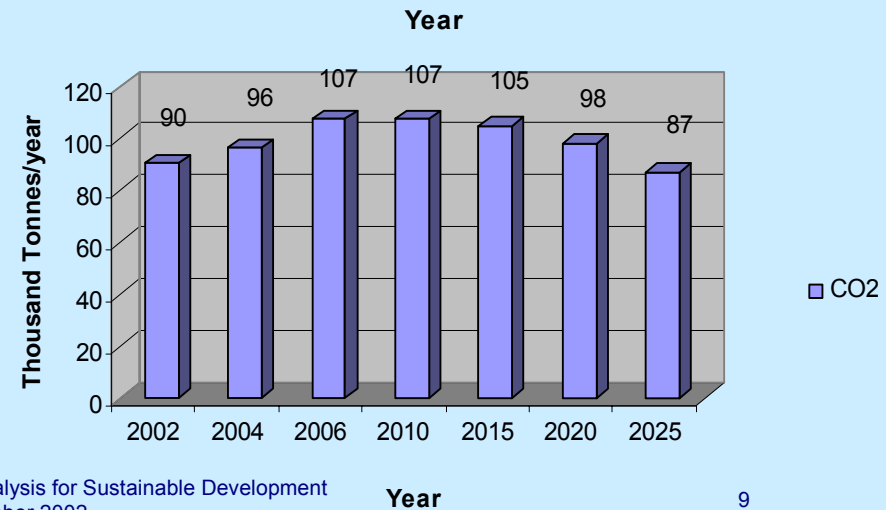
Non environmental or fuel supply constraints, or financial incentives to promote renewables, leave the market forces to choose the lowest cost of power supply.

2) Market Penetration of Renewables (Wind)

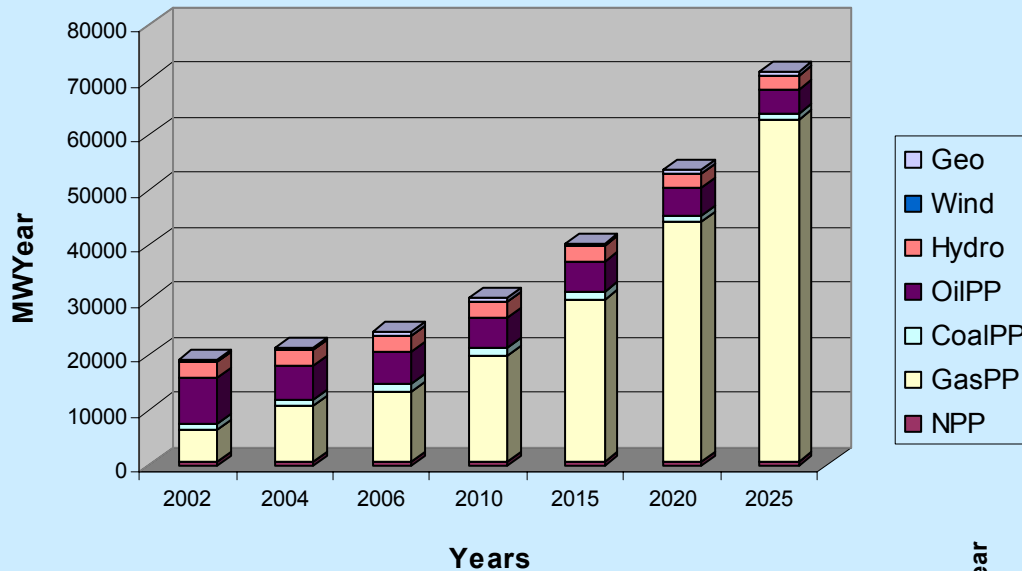


- A 38,5% incentive over investment costs triggered penetration of wind technologies to 900 MWyr by 2004.

- Stabilization and eventual reduction of Acid Rain gases, CO2 and PST due to displacement of Thermal Plants by Cleaner Wind Technology

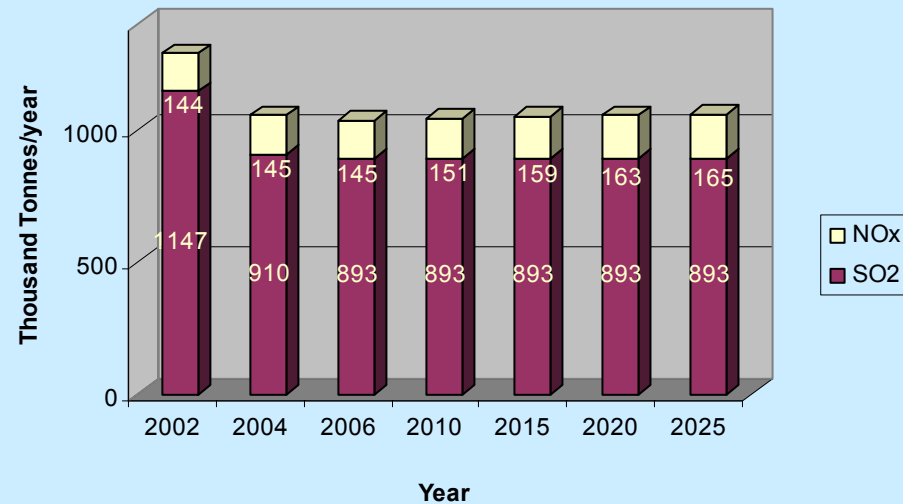


3) Environmental Restrictions

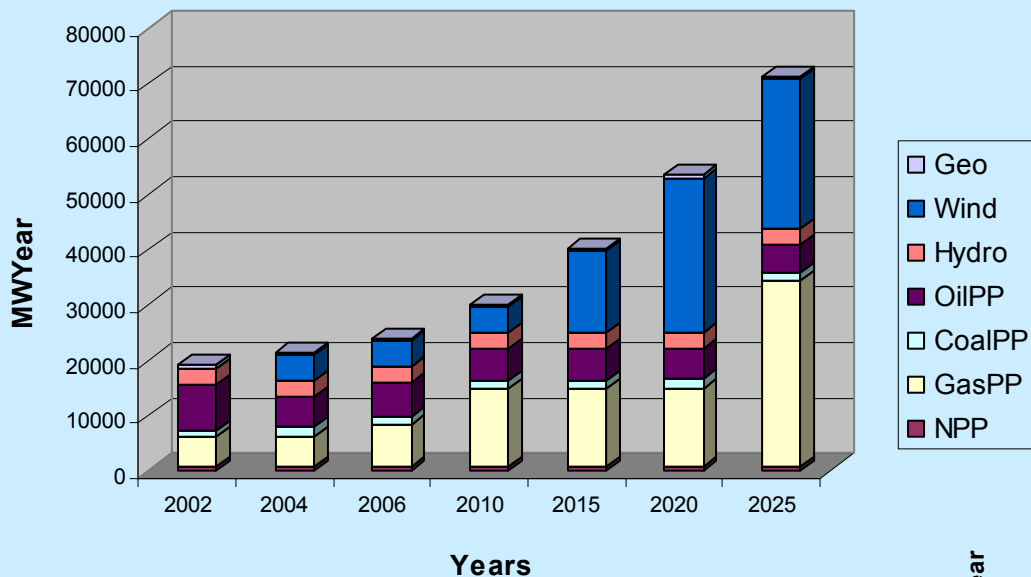


Cleaner Low cost Gas C.C. Technology dominates. Low cost non clean Oil and Carbon Technologies will be phased out.

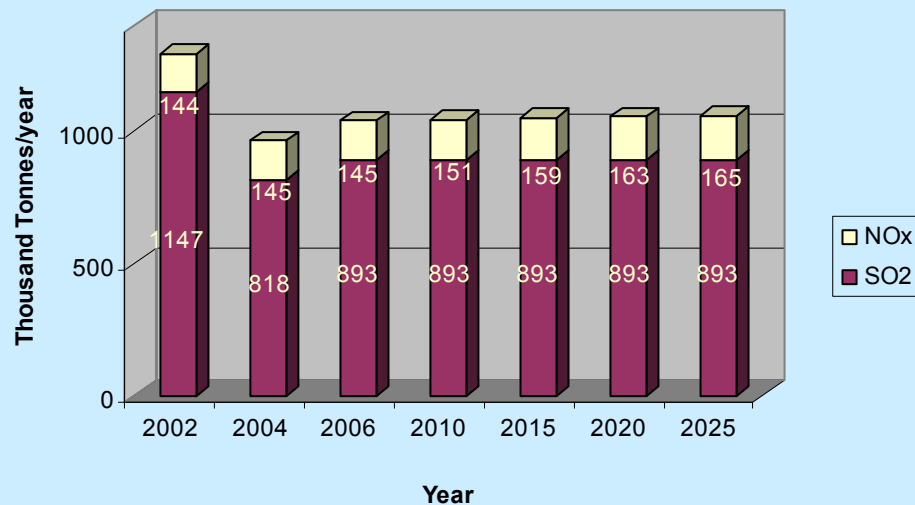
Emission constraints in Acid Rain gases (SO₂, NO_x) reduces SO₂ more than 50% (base year 2000 1710 thousand tonnes) by 2006 and lowers more than 10 times the emission intensity of NO_x in new CC Technologies.



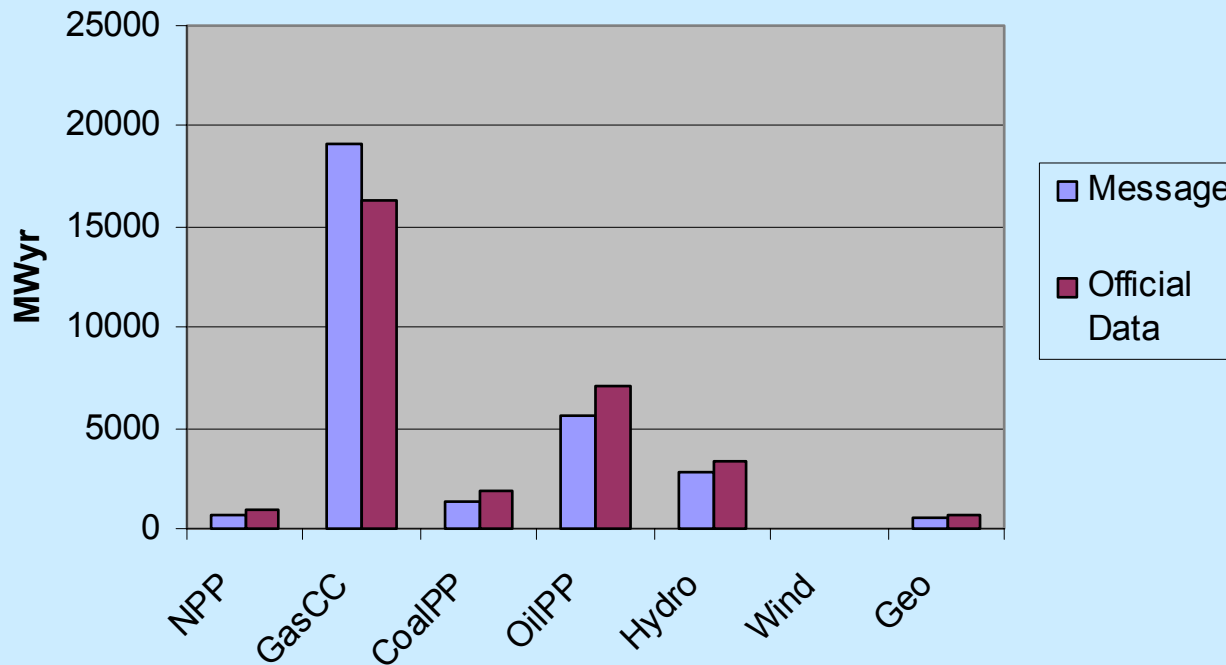
3) Environmental Restrictions & Incentives on Renewables



• The effect of Emission restrictions lowered the incentive on inv. costs for triggering wind, down to 33%.



Electricity Supply (2010)



Comparison of results (0-8.5%)

Conclusions & Future Work

- Lower cost technologies dominate when no restrictions are applied.
- Dependence in low cost CC gas technologies may create problems of fuel resource supply.
- Need to model the risk of future fuel supply and include it into the cost of CCP technology (Mexico urges to expand NG extraction capacity & installation of LNG facilities in order not to increase imports share or diversify the origin of imports).
- Emission restrictions & program incentives for alternative technologies deal to cleaner energy energy supply and diversification of technology offer.
- Mexico counts with proved potentials of over 10000 MW & 12000 MW in Wind and Geothermal Energy Resources; as well as more than 40000 MW in Hydro and Mini-hydro yet to be exploited.
- Financial instruments like Green Funds (with Federal & International Organization Sources) are being designed to provide incentives for renewables. Green Funds maybe replenished through carbon credits (CDM) and green electricity credits.

Comments on Message

- Feasible tool for Modeling a Sustainable Expansion of Energy Sector
- Need to improve for a more friendly Interface with the user (Graphic Interface highly desirable)
- Need a more friendly way to access the results
- Highly desirable to have in hand an improved version of the Operation Manual
- Desirable to keep updated Libraries of standardized parameters for users (Countries Parameters)
- Iterative problems derived from linear programming



Thank You!!