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INDICATORS FOR SUSTAINABLE ENERGY DEVELOPMENT

Mexico

contents

1 An Overview of the Mexican Energy Sector

Relevance of the Energy Sector in Mexico

- 3% to the GDP
- 8% of total exports
- 37% of the oil-related taxes for Federal budget
- 70% public investment is directed to energy projects
- Mexico: 9th country worldwide in crude oil reserves; 4th in natural gas reserves in America after USA, Venezuela and Canada
- PEMEX: the 7th petroleum worldwide by crude oil output
- CFE: the 6th largest power company in the world
- In gross electricity generation, Mexico ranks 16th worldwide
- 95% of population is connected to the grid (95 M hab)

1 An Overview of the Mexican Energy Sector

Continued

Energy within national planning

- *National Plan of Development 2001-2006:* vision, objectives and strategies of the Executive Branch

- *National Energy Sector Program 2001-2006* contains, vision, situation analysis, objectives, policies, priorities, strategies and specific actions of the energy sector

1 An Overview of the Mexican Energy Sector

Continued

Priority areas in the Energy Sector:

- Guarantee a reliable energy supply
- Adequate legislation for the development of the energy sector
- Enhance the participation of Mexican enterprises
- Energy efficiency programs / renewable energies.
- Foster a safe and reliable use of nuclear energy
- Leadership in risk prevention
- Leadership in the protection of the environment
- Promote the development and application of advanced science and technology
- Expand and foster international cooperation on energy matters
- Improve service quality

1 An Overview of the Mexican Energy Sector

Continued

Energy Sector Challenges

Growth demand forecast (2001-2009): electricity 70%,LPG 35%, natural gas 120% and liquid fuels 45% requires:

- 40 billion in exploration and production,
- 19 billion in refining,
- 21 billion in natural gas and
- 59 billion in electricity

Total: 139 billion dollars to expand and modernize Mexico's energy infrastructure

2 Energy Statistical Data Capability of SENER and INEGI

SENER and INEGI Capability

- Annual National Energy Balance
- Prospective studies in the energy sector: electricity, NG, LPG and hydrocarbons.
- Environmental indicators with SEMARNAT
- Data on social and economic aspects of the country (national census of population and housing, and economic, the SNA, the SEEA (estimation of ecological GDP)
- Data on the physical milieu, natural resources, infrastructure and territory (e.g. aerial photography and satellite imagery)
- Conceptual/methodological guidelines of statistics and indicators on natural resources, environment and sustainable development, for public administration's planning and management.

3 Selected Energy Priority Areas to be Assessed by using the ISED System

Usefulness of ISED indicators

- ✓Assess government's fulfilment of National commitments,
- ✓Identify opportunity areas for institutional improvement and
- ✓Policy implementation

3 Selected Energy Priority Areas to be Assessed by using the ISED System

Continued

ENERGY POLICY ISSUES AND GOALS OF MEXICAN ENERGY SECTOR*	ISED CORE SET OF IAEA	RESPONSE ACTIONS ON TARGETED INDICATOR	POLICY MEASURES ON TARGETED INDICATOR
Context indicators	1, 2, 4, 7, 19	Monitor macro socio-economic tendencies and refocus energy policies	·Implement or adjust energy policies. ·Link energy policies to socio-economic concerns. ·Eliminate energy subsidies except for the poor population.
Goal 1: "Guarantee a reliable energy supply, according to international quality standards, and competitive prices"	3, 11, 15, 17, 18, 22, 36, 37	Allows the decision making in investment, taxes, energy supply, and imports policies. Establish a relationship between generation sources and fuel types.	· Increase share of natural gas in fuel mix. · Increase share of renewable in fuel mix. · Improve the maintenance and upkeep of existing energy infrastructure.
Goal 4: "Improve energy efficiency programs and development of renewable energies."	5, 6, 8, 9, 10, 12, 14, 16, 20, 21, 35, 40	It can be used to evaluate the evolutions of the efficiency and energy saving policies, to establish energy supply and renewable energy policies.	·Integrate environmental concerns into energy policies. · Optimise economic activity levels through reducing shares of energy intensive. · Decrease energy intensities through end-use energy efficiency improvement. · Increase efficiency of energy supply, in particular for electricity generation. · Integrate energy efficiency in sectoral policies. · Implement advanced, environmentally-sound technologies with lower specific fuel consumption. · Switch to more environmentally benign fossil fuels, such as natural gas.
Goal 7: "Leadership in the protection of the environment".	13, 23, 24, 25, 26, 29, 30, 33, 41	Establish a relationship between emissions and control- mitigation policies to reduce environment impact. Use cleaner fossil fuels and renewable energy Measure land efficiency use by energy sector	· Include externalities in full cost of energy. · Implement legal and regulatory frameworks and enabling environment favouring energy conservation and efficiency. · Improve material intensities across sectors.
Goal 6: "Leadership in risk prevention of the productive operations of the energy sector".	34	Risk evaluation and control policies.	
Goal 5: "Foster a safe and reliable use of nuclear energy maintaining the highest safety international standards".	27, 28, 31, 32, 38, 39	Environmental and safety policies. Policies for radioactive waste. Supply uranium.	

4 Results and Experiences with Indicators Implemented from the ISED Framework

Results

INDICATORS OF SUSTAINABLE ENERGY DEVELOPMENT IN MEXICO

Assessment of Features and Work Process for Selected Indicators

No.	IAEA Indicators List	Not available	Data availability and/or conceptual difficulty	Elaborated / Feasibility	Responsible Institution
1	Population: Total and percentage in urban areas 1950-2000			☺	INEGI-SENER
10	Energy intensity of selected energy intensity products	☒	Define intensive products; data request and adequacy in progress.	😐	SENER
11	Energy mix			☺	SENER and others
12	Energy supply efficiency	☒	Data adequacy in progress.	☹	CFE, LFC & PEMEX .
15	Expenditure on energy sector	☒	Data request and adequacy in progress. Hydrocarbon and electricity: Sector's agencies	😐	PEMEX, CFE, LFC
21	Fraction of disposable income/ private consumption spent on fuel and electricity			☺	INEGI
25	Land area where acidification exceeds critical load	☒	Conceptual or methodological difficulty; data not sufficient.	😐	SEMARNAT
34	Fatalities due to accidents with breakdown by fuel chain	☒	Data request and adequacy in progress - Hydrocarbon agency.	☹	SENER, PEMEX
37	Lifetime of proven fossil fuel reserves			☺	PEMEX
38	Proved uranium reserves	☒	Classified information. National Security. Data request and/or adequacy in progress.	☹	CONASENUSA, ININ, CFE
40	Intensity of use of forest resources as fuel wood			☺	SENER
41	Rate of deforestation	☒	Request and/or adequacy of information in progress	😐	PEMEX, CFE, LFC, SEMARNAT

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Results

From a total of 41 indicators of ISED package, the results achieved by Mexico are:

- ☺ 28 have been elaborated
- 😐 8 are feasible in medium term
- ☹ 5 are feasible in long term

The elaborated indicators and its information were displayed into four thematic categories:

a) Socio-economic aspects:	**5** (5)
b) Energy Supply:	**7** (8)
c) Energy Production and Consumption Patterns:	**8** (12)
d) Environmental protection and safety policies:	**8** (16)

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

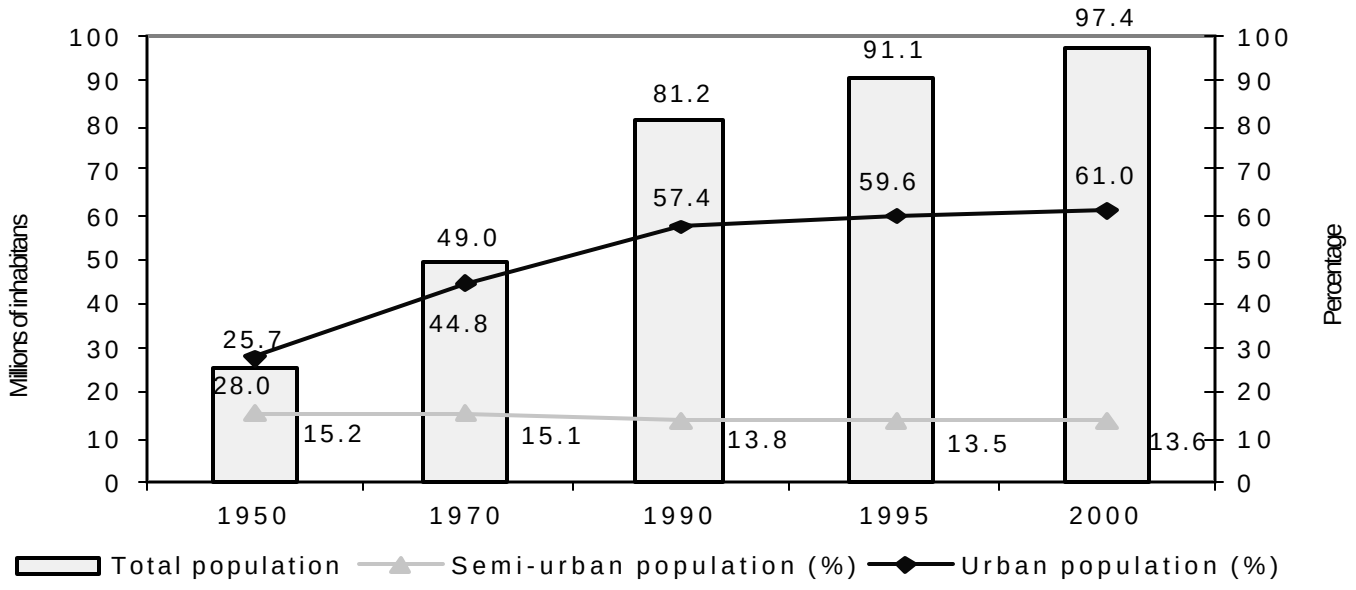
Experiences and lessons learnt

- Most of indicators elaborated adjust to proposed definition
- Expand time series / indicator require further review
- Some indicators require special process of research in order to gather the information
- Some other indicators present difficulties to adequacy data with proposed methodology sheet
- Classified information (U reserves)
- Those one whose feasibility require an inter-institutional development

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Context indicators: #1 Total and % population in urban areas

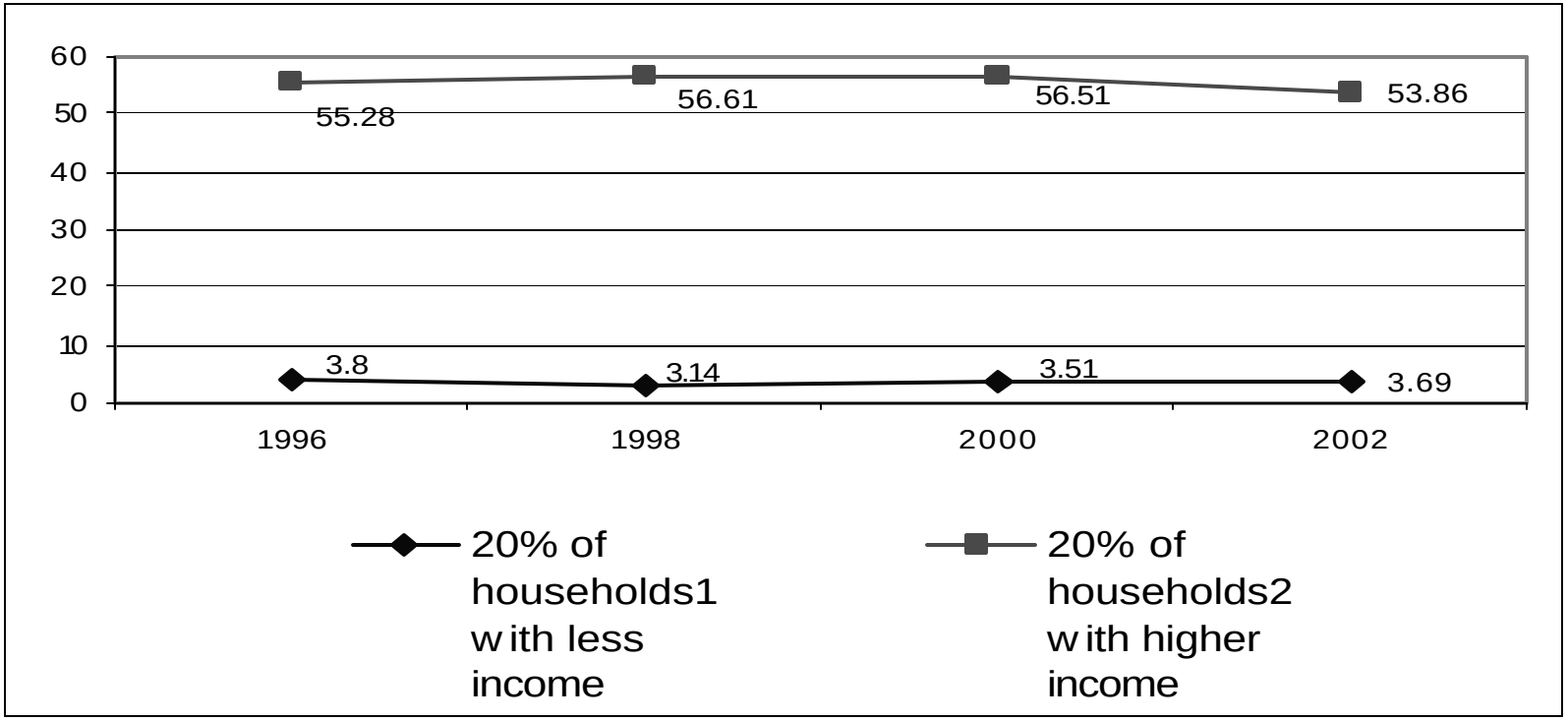


National growth rate went from 3.3% in the 1950-1970 period, to 1.6 in the 1995-2000 period.

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Context indicators: #19 income inequality



4 Results and Experiences with Indicators Implemented from the ISED Framework

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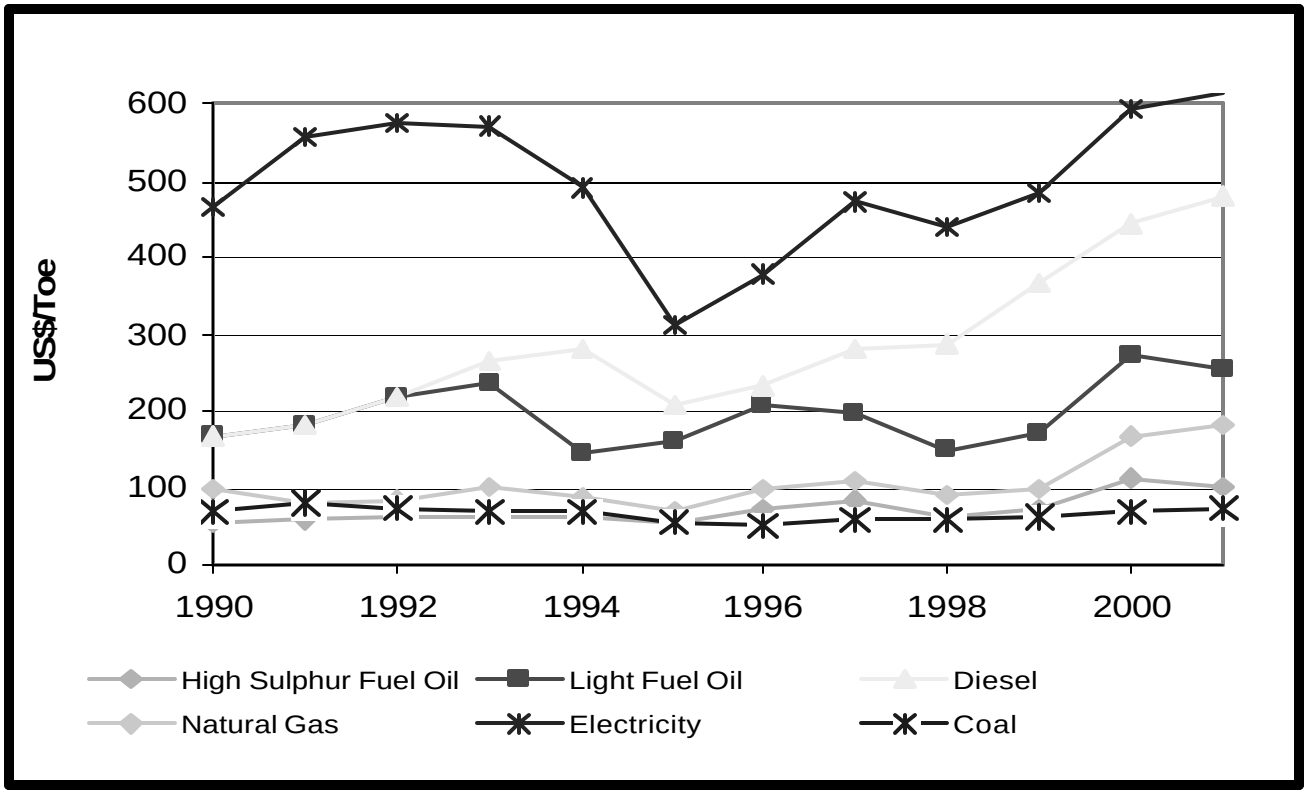
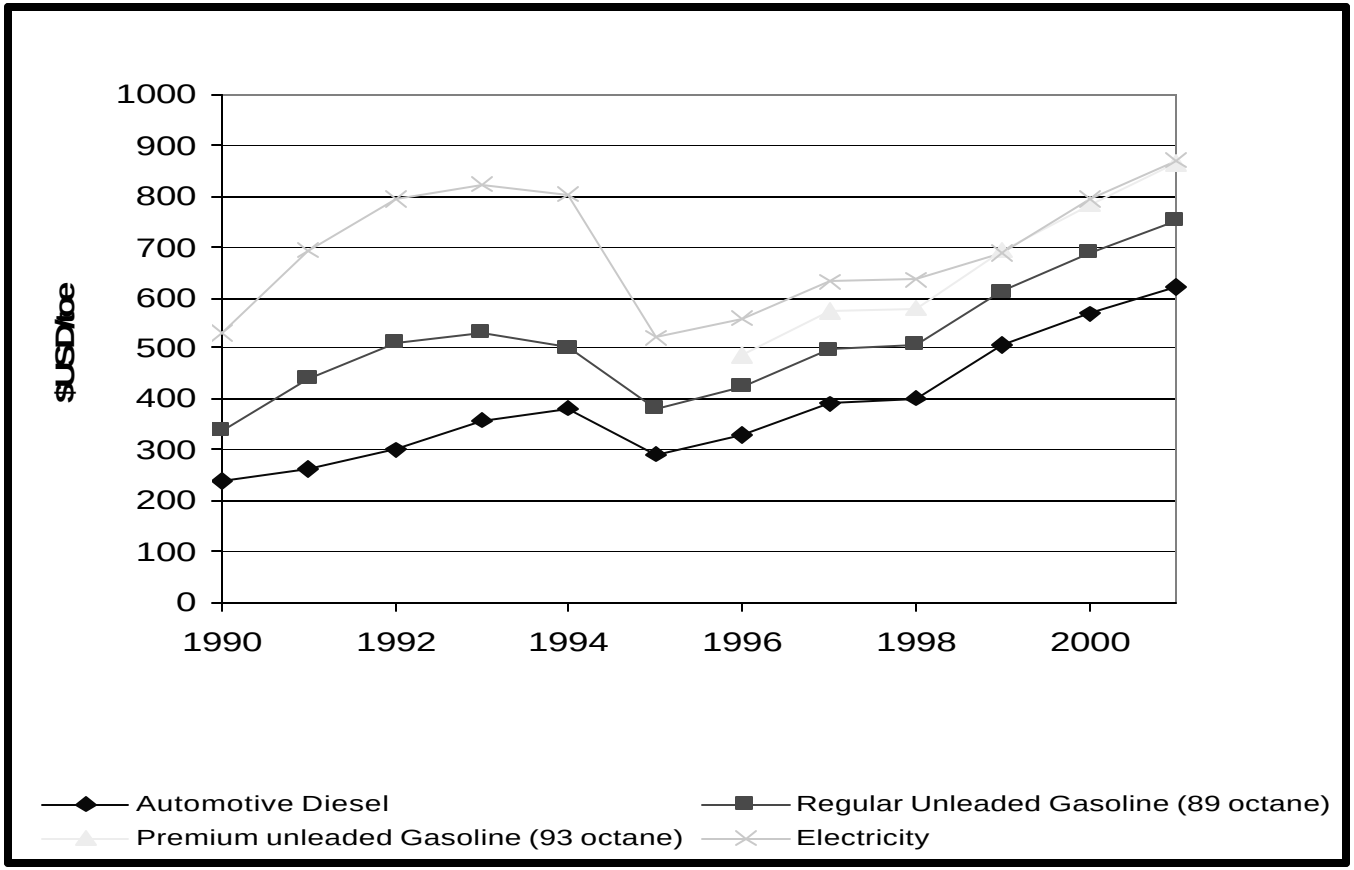
Energy supply: # 3 energy prices: industrial & power



4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

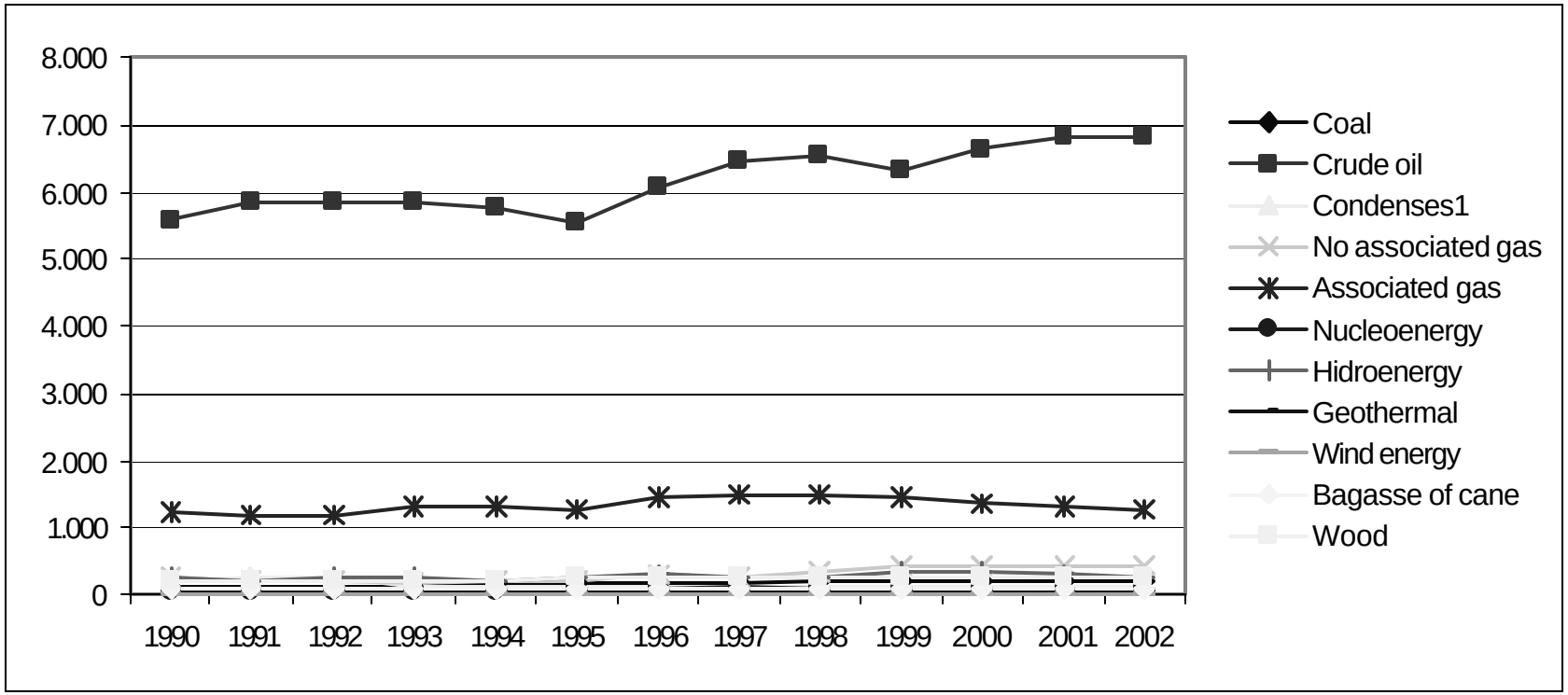
Energy supply: # 3 energy prices: transport



4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Energy supply: # 11 energy mix (supply)



4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Energy supply: # 11 energy mix (supply)

b) Primary energy supply (PJ) 2nd and last part

	1996	1997	1998	1999	2000	2001	2002
Coal	191.191	189.709	199.411	203.846	226.702	223.201	220.268
Crude oil	6,079.177	6,463.785	6,562.912	6,351.474	6,619.787	6,811.686	6,798.976
Condenses[1]	148	148.303	145.902	124.917	130.705	137.659	121.988
No associated gas	286.903	281.251	362.929	422.171	434.830	430.619	445.646
Associated gas	1.432.514	1,489.900	1,490.161	1,456.595	1,371.203	1,317.402	1,271.959
Nucleoenergy	85.581	112.495	100.471	108.260	90.331	96.699	106.972
Hidroenergy	322.316	271.153	252.956	336.146	342.066	291.822	259.054
Geothermal	58.729	56.075	58.132	57.778	61.030	57.132	56.246
Wind energy	.051	.041	.051	.062	.083	.071	.072
Bagasse of cane	87.211	95.971	99.277	91.979	88.037	92.996	88.646
Wood	245.068	246.538	248.021	251.898	253.868	253.444	255.087
Total	8,937.141	9,355.221	9,520.223	9,405.126	9,618.642	9,712.731	9,624.914

[1] Refered the recovered condensated in pipes of gas.

Source : Balance Nacional de Energía, Secretaría de Energía, 2003.

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Energy supply: # 11 energy mix (supply- electricity)

Electricity generation

	Capacidad instalada (%)					
Year	**Coal**	**Nuclear**	**Hidro**	**Geothermal**	**Wind**	**Conventional thermal**
1990	4.7	2.7	30.9	2.8	-	59.0
1991	4.5	2.5	29.6	2.7	-	60.7
1992	4.4	2.5	29.3	2.7	-	61.1
1993	6.5	2.3	28.0	2.5	-	60.7
1994	6.0	2.1	28.8	2.4	0.01	60.7
1995	6.8	4.0	28.2	2.3	0.01	58.7
1996	7.5	3.8	28.8	2.1	0.01	57.8
1997	7.5	3.8	28.8	2.2	0.01	57.8
1998	7.4	3.7	27.5	2.1	0.01	59.3
1999	7.3	3.7	27.0	2.1	0.01	59.9
2000	7.1	3.6	26.2	2.3	0.01	60.8
2001	6.6	3.3	24.3	2.1	0.01	63.8
2002	6.3	3.2	23.3	2.0	0.00	65.2

Total installed capacity 2002: 41,177 MW; estimated 2012: 62,730 MW

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

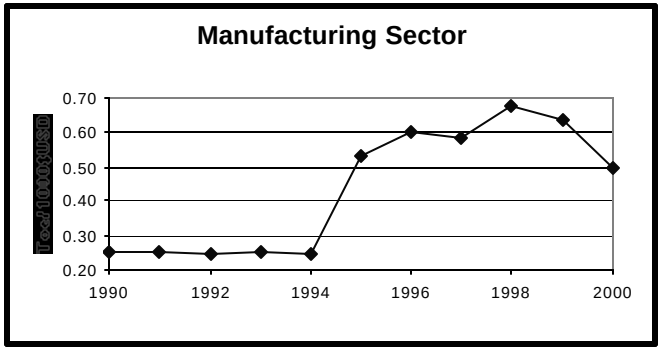
Energy supply: #17 indigenous energy production

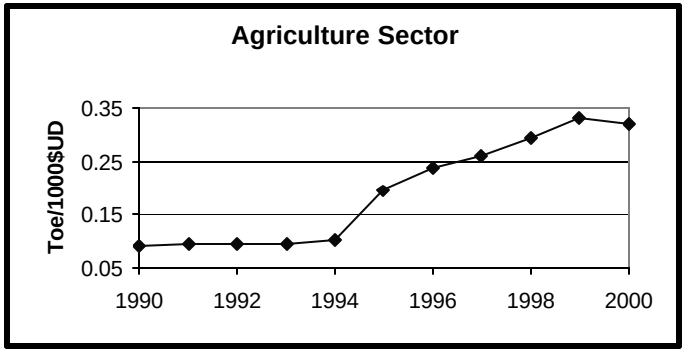
	Indigenous Energy Production (Mtoe											
Year	Coal (Mtoe)	Crude oil (Mtoe)	Condensed Fuels (Mtoe)	Non Assoc. Gas (Mtoe)	Assoc.Gas (Mtoe)	Nuclear (Mtoe)	Hydro (Mtoe)	Geothermal (Mtoe)	Wind (Mtoe)	Sugar cane (Mtoe)	Wood (Mtoe)	Electricity (TWh)
1990	3.39	133.12	5.44	5.83	29.45	0.74	6.01	1.32	-	1.92	5.58	114.25
1991	3.07	139.83	6.14	5.57	28.39	1.10	5.56	1.39	-	2.11	5.62	118.37
1992	2.86	139.59	6.41	5.27	28.11	1.00	6.59	1.47	-	1.96	5.67	121.66
1993	3.09	139.99	3.62	4.54	31.10	1.27	6.55	1.47	-	2.15	5.72	126.58
1994	4.18	137.46	3.38	4.86	31.86	1.14	4.98	1.39	0.0010	1.79	5.77	137.53
1995	4.13	132.66	3.55	5.69	30.47	2.22	6.78	1.40	0.0015	2.10	5.82	142.36
1996	4.57	145.20	3.54	6.85	34.22	2.04	7.70	1.40	0.0012	2.08	5.85	151.90
1997	4.53	154.38	3.54	6.72	35.59	2.69	6.48	1.34	0.0010	2.29	5.89	161.40
1998	4.76	156.75	3.48	8.67	35.59	2.40	6.04	1.39	0.0012	2.37	5.92	171.00
1999	4.87	151.70	2.98	10.08	34.79	2.59	8.03	1.38	0.0015	2.20	6.02	180.93
2000	5.41	158.11	3.12	10.39	32.75	2.16	8.17	1.46	0.0020	2.10	6.06	192.78
2001	5.71	162.69	3.29	10.28	31.56	2.31	6.97	1.36	0.0017	2.22	6.11	197.25

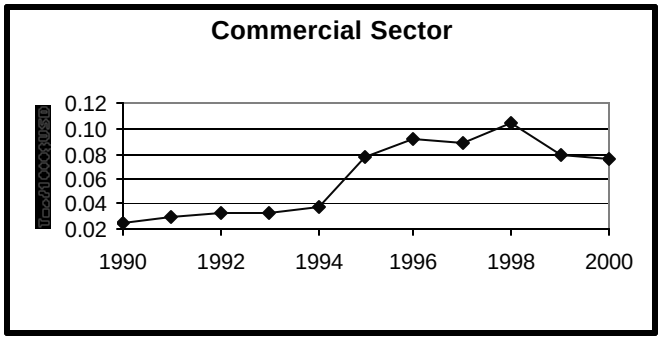
4 Results and Experiences with Indicators Implemented from the ISED Framework

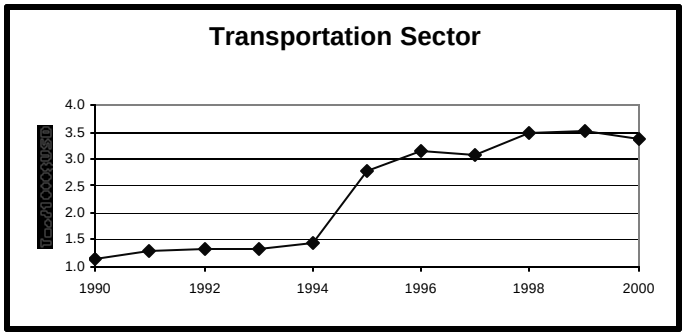
Continued

Energy production and consumption patterns: #9 energy intensity for different sectors









4 Results and Experiences with Indicators Implemented from the ISED Framework

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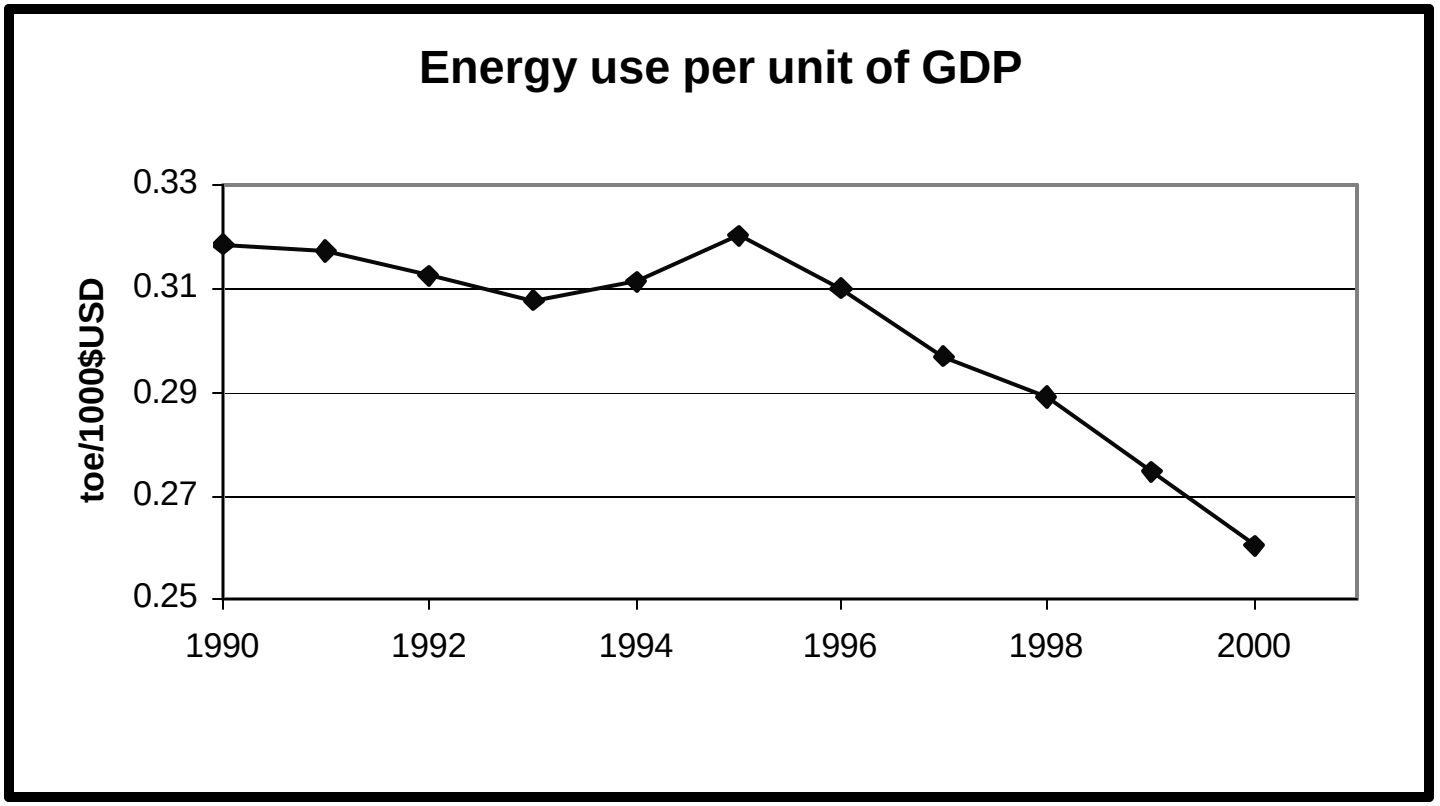
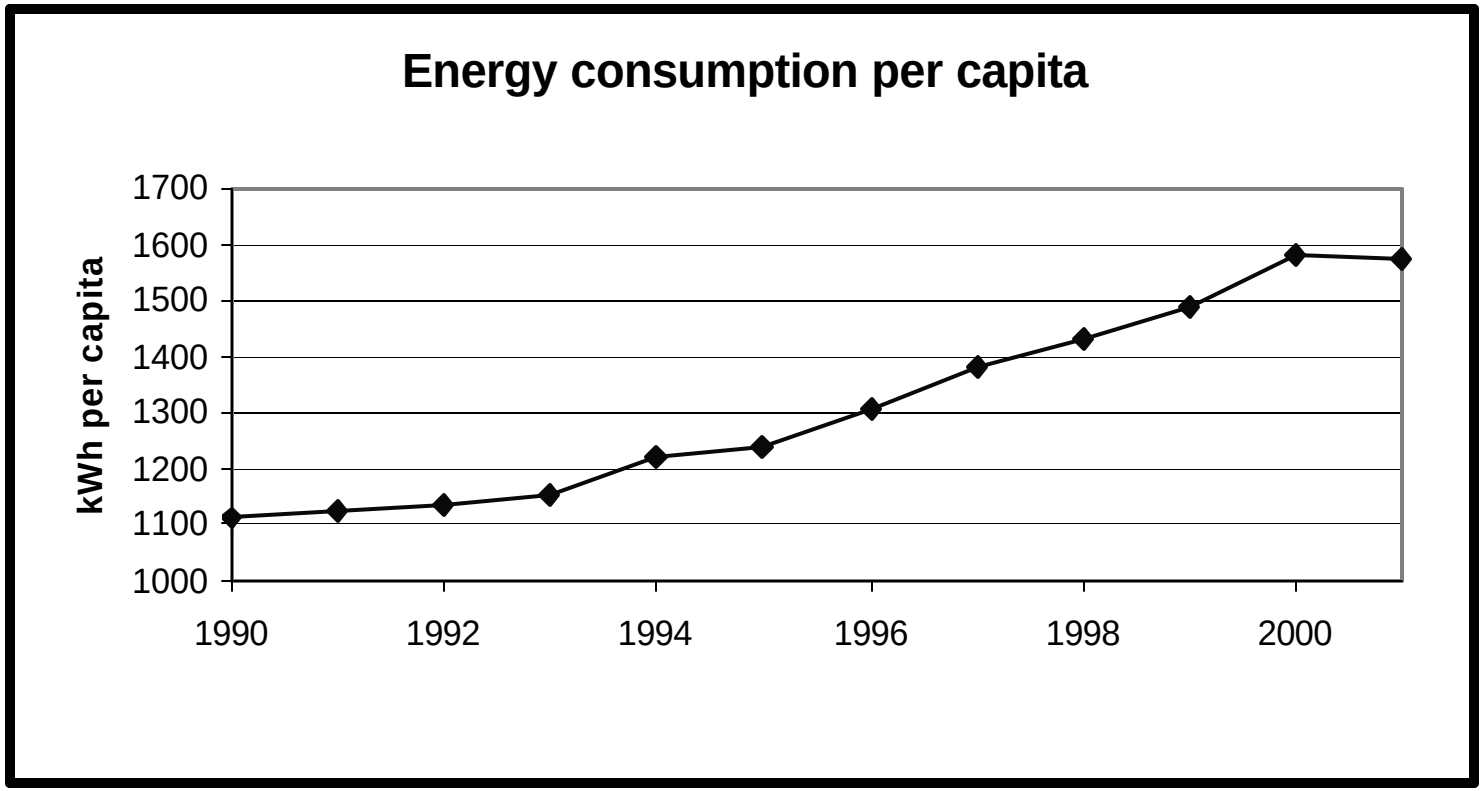
Energy production and consumption patterns: #14 energy use per unit GDP



4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Energy production and consumption patterns: #16 energy consumption per capita (electricity)



4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Environmental protection and safety policies: #23 emission intensity for CFE and PEMEX

Year	CO_2 Ton/GWh	NOx Ton/GWh	SO_2 Ton/GWh	Particles (TSP) Ton/GWh
1995	**716833**	1,937	12,377	0.782
1996	**708045**	2,006	12,126	0.763
1997	**712365**	1,927	12,482	0.789
1998	**712430**	1,903	12,357	0.782
1999	**708223**	1,915	12,020	0.762
2000	**713354**	1,918	11,882	0.756
2001	**688383**	1,946	10,907	0.698

Year	VOC Ton/MTon	NOx Ton/MTon	SO_2 Ton/MTon	Particles (TSP) Ton/MTon
2000	2.998298391	0.258687029	0.27095314	0.319584438
2001	2.230634104	0.229341395	0.271351905	0.235237635
2002	2.546783624	0.252577759	0.295593964	0.239005276
2003	2.364998879	0.224605699	0.291839792	0.244471869

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Environmental protection and safety policies: #26 total GHG emissions

Total GHG Emissions (Gg)					
Total Emissions and Capture	**CO_2**	**CH_4**	**N_2O**	**NOx**	**CO**
1994	351459.73	6594.86	43.80	1079.43	8260.40
1996	514048.06	7507.03	46.52	1123.47	8691.12
1998	394725.96	8060.65	47.45	1151.71	5928.20

4 Results and Experiences with Indicators Implemented from the ISED Framework

Continued

Presentation format for indicators and information

- *Indicator Name*
- *Indicator Definition*
- *Relevance to Sustainable/Unsustainable Development*
- *Tables and graphs*
- *Trends*
- *Indicator Construction and Limitations*
- *Technical Sheet Indicator:*

INDICATOR:	**FINAL ENERGY INTENSITY OF SELECTED ENERGY INTENSIVE PRODUCTS**		
Dimension and Postulates	Placement in the ISED Conceptual Framework (PSR Framework)	Placement in Agenda 21	Placement in the CSD Theme/Sub-theme (Blue Book, 2002)

5 Conclusions and Perspectives

Public investment must be promoted in the following areas:

- Electricity generation and transmission
- Non-associated gas production and gas processing
- Refining
- Renewable energies- federal Government committed: 1000 MW of renewable energies would be installed (with out considering geothermal and large hydro), until now only 15 MW have been effectively installed (8 MW mini hydro and 7 MW biogas)

5 Conclusions and Perspectives

Continued

- An increasing dependence on imports of oil-refined products has led to investments in the Refinery sub sector of over 13 billion USD for the 1994-2003 period. Over the next 10 years demand, specially of gasoline and NG, will exceed national supply thus imports will continue to grow

- Structural Reforms proposed by the Executive Branch, main issues include:

  - Financial and operational autonomy for the national energy companies
  - Fiscal reforms for PEMEX and CFE so that they are no so heavily taxed
  - Gradual modifications on the electricity tariffs, including transparency in subsidies
  - Legal reforms that give certainty to investors in the Energy Sector, without privatising PEMEX and CFE

5 Conclusions and Perspectives

Continued

- Promote the use of indigenous energy sources (e.g. fuel oil in electricity generation with proper emission control devices)
- Implementation of an SO_2 market
- PEMEX is now operating a virtual CO_2 market
- Although Mexican laws consider the pacific use of energy resources, no consideration is given in the energy forecasts: Further discussions regarding this issue must be raised at the national level
- Further environmental indicators proposed (waste, wastewater,etc.)