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Assessment of Electricity Generation to 2011 Using Low Sulfur Fuel Oil in Mexico

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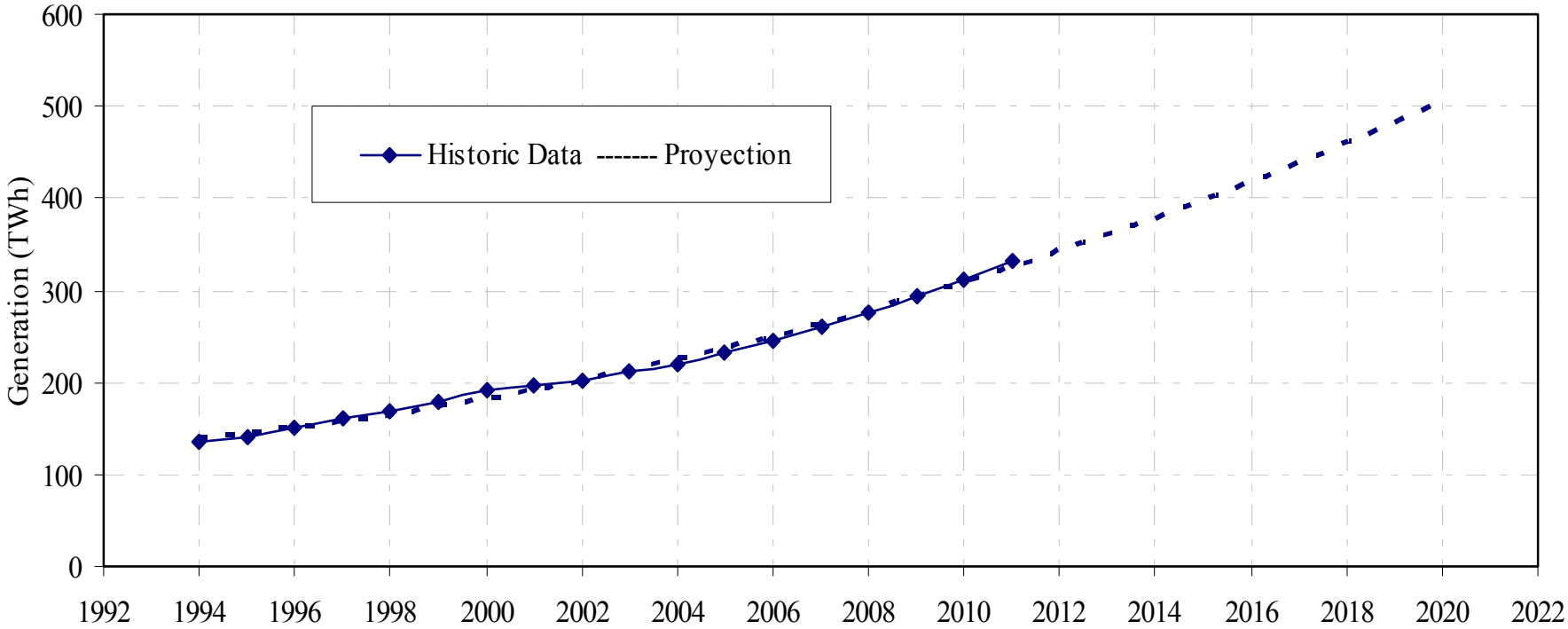
Generation of Electrical Energy

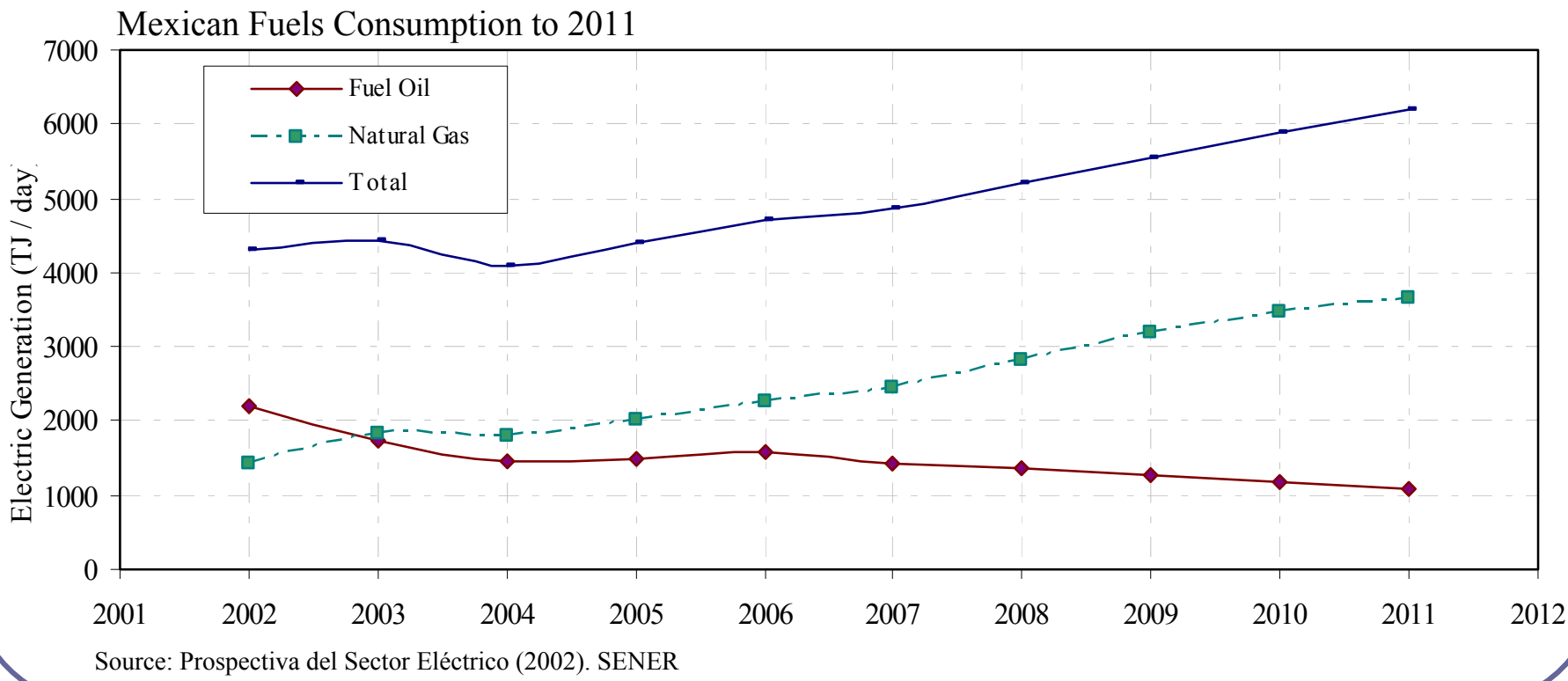
The energy perspectives in matter of electrical energy consumption indicate the need of available technologies revision, on the basis of a programmed investment to face the power demand that is approached in the next years and will continue being increased as the country is developed.



Source: CFE / Prospectiva de Energía de México (2002). AIE-SENER

Fuel Oil by Natural Gas

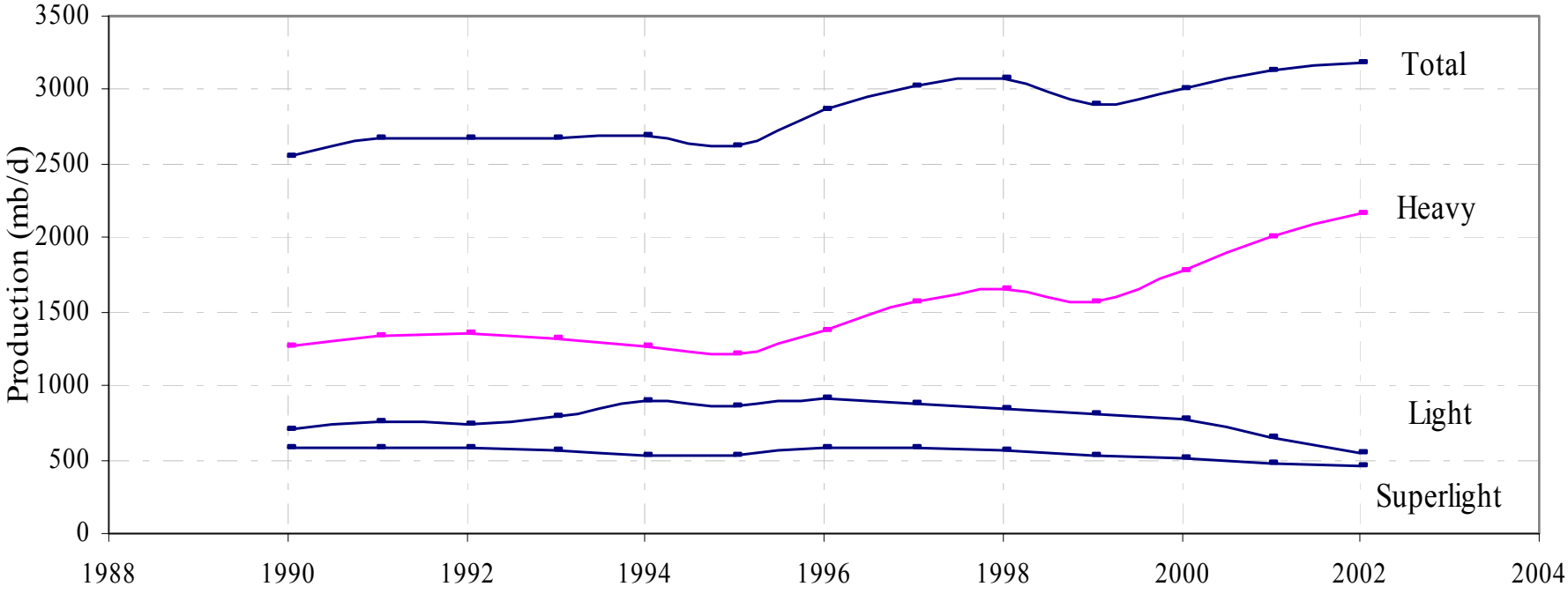
In Mexico, the fuel oil produced in the National System of Refineries (NSR) is being substituted by natural gas due to environmental restrictions, prices respect to natural gas and the reduction in the production by the NSR.



Source: Prospectiva del Sector Eléctrico (2002). SENER

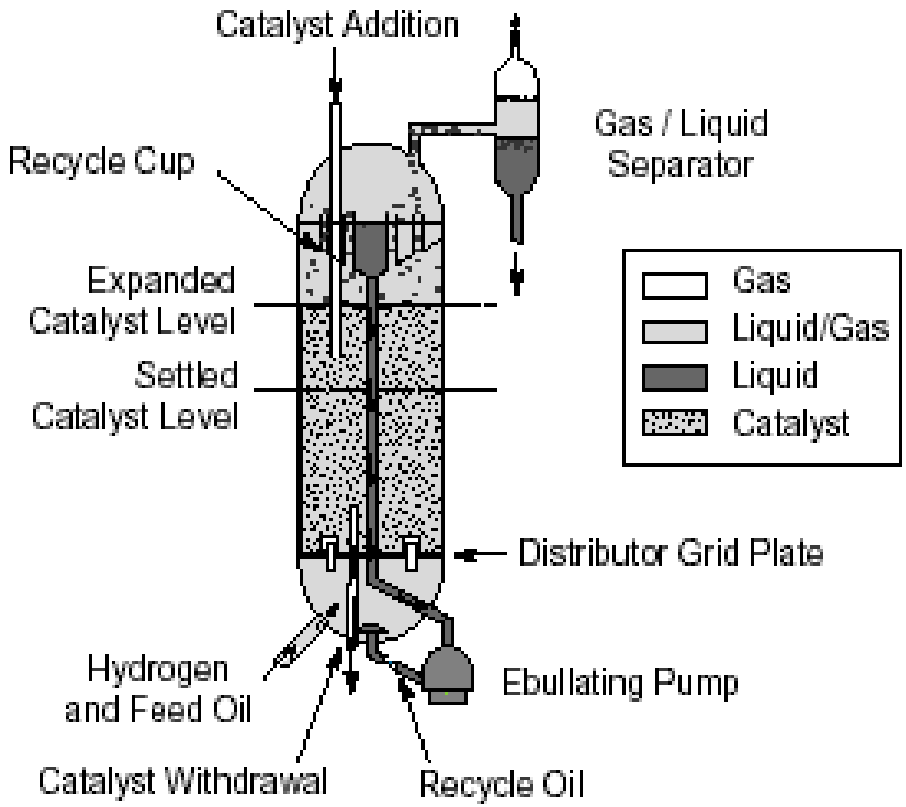
Heavy Oil Processing

The production of oil in Mexico in the next years will be predominantly heavy oil. In order to support this, the NSR is conducting refinery reconfiguration projects with the objectives to increase the heavy oil processing capacity, produce cleaner fuels and reduce the residual production of fuel oil and heavy fractions.



Source: PEMEX-Producción

Ebullated Bed Reactors Technology

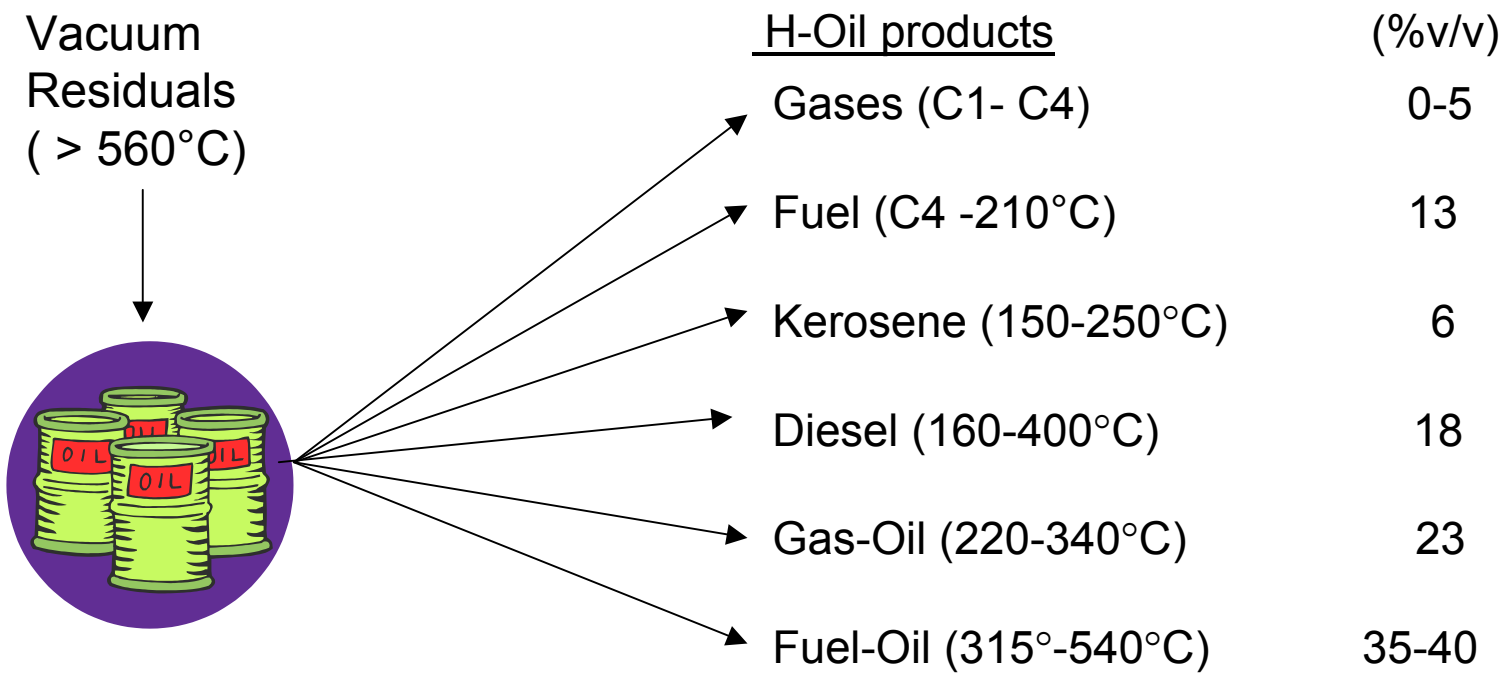


It is necessary to consider bottom-of-the-barrel technologies since the fuels produced by these processes contain low sulfur levels (0.45 to 1% w/w), nitrogen and metals. The feed for this kind of processes can be asphalts and vacuum residuals with high sulfur, nitrogen and metal contents.

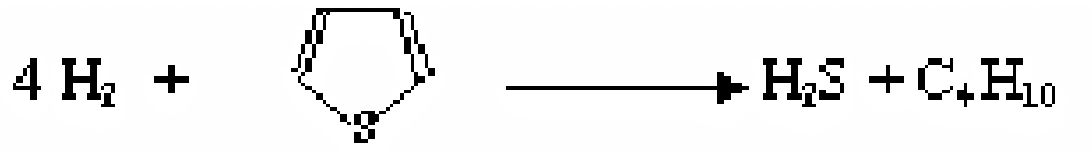
Source: J.J Coylar (1997). *Ebullated-Bed Reactor Technology*. HRI/IFP

The Ecological Fuel-Oil: An Electric Power Generation Alternative

This Technologies are design to process Heavy Vacuum Residuals, and produce valuable lubricants and minimum amounts of polluting gases.

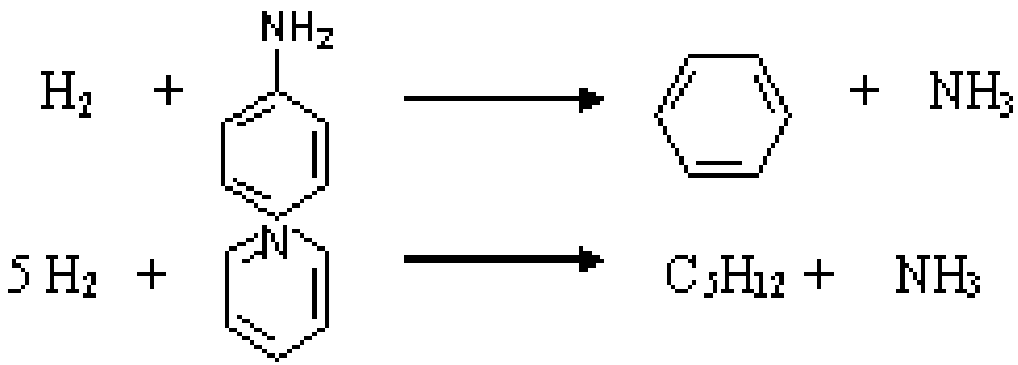


Catalytic Hydrocraking in H-Oil- HDR Process

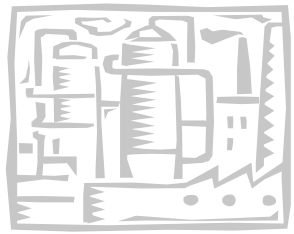


$C_{20}H_{42} + H_2 \longrightarrow 2\,C_{10}H_{22}$

$C_{20}H_{42} + H_2 \longrightarrow C_{14}H_{34} + C_4H_{10}$



Vacuum Residue Hydroprocessing Characteristics



Characteristics	H-Oil (HDR)	LC-Fining	
Temperature, °C	410-450	385-450	
Pressure H_2, kg/cm^2	70-175	70-189	
Charge:	Vacuum Residuals		
°API	7.4	4.73	
Sulfur, %p	4.85	4.97	
(Ni+V), ppm	295	181	
Products, % w/w			
C_1-C_4	3.5	C_4-	2.35
C_4-204°C	17.6	C_5-177°C	12.60
204-371°C	22.1	177-371°C	30.62
371-565°C	34.0	371-550°C	21.46
C_4>	95.4	550°C$^+$	40.00
H_2 use pie^3/ b	1410	1350	

In every place where barrel bottoms are processed, it will be necessary to have a Residual Catalytic Hydrocraking process, like the H-Oil or LC-Fining technologies that have been widely accepted in: Japan, USA, Canada, Kuwait, Poland, Italy and Mexico (Salamanca and Tula).

Scenarios to 2011 for Electric Generation: Gas vs Fuel Oil

Annual Economic Indicators Variations 2002-2011

Variable / Scenario	Plausible	Extreme	Middle
PIB Growth	**4.5%**	5.6%	3.4%
Fuel Oil annual price variation	**-0.2%**	-0.3%	0.5%
Natural Gas annual price variation	**0.6%**	0.5%	1.4%
2011 Electric consumption	**291.5 TWh**	313.1 TWh	266.7 TWh

Energy Growth to 2011

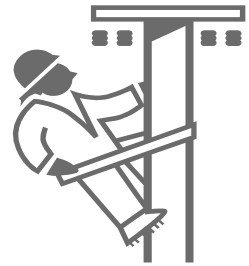
Energy Demand to 2011

(TWh)	**Plausible***	Extreme	Middle
2002	**163**	163	163
2011	**291**	313	266
Δ (%)	**128 (78)**	150 (92)	103

New capacity to 2011

(MW)	**Oil Fired**	**CCGT**
2002	41095	41095
2011	60637	59415
Δ (%)	19542 (47)	18,320 (44)

Consumptions and Thermoelectric Plants to 2011



Number of new thermoelectric plants to 2011

(1500 MW)	Oil Fired	CCGT
Plants to install	13	13

Additional Fuel Oil to 2011.

Volume	H-Oil Fuel Oil
MMB/year	202
MMB/year* plant	15
b/day*plant	42,740

Natural gas to CCGT plants 2011.

Volume / Scenario	CCGT Plants
MM CFD	2,650
MM ft^3/year* Plant	74,404

Projects Characteristics

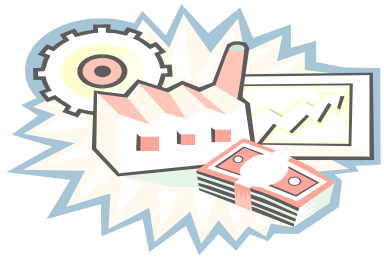
CCGT
Fuel: Natural Gas
Plants: 13 centrals
26 plants of 2X1 “G” 1x 737 MW
Fuel Costs 4572 MMUSD/year

→ Less expensive technology costs
Gas importation dependence
And Volatile prices

Oil-Fired Technology
13 Centrals of 1500MW
13 H-Oil (HDR) of 50,000 BPD
Fuel Cost 4572 MMUSD/year

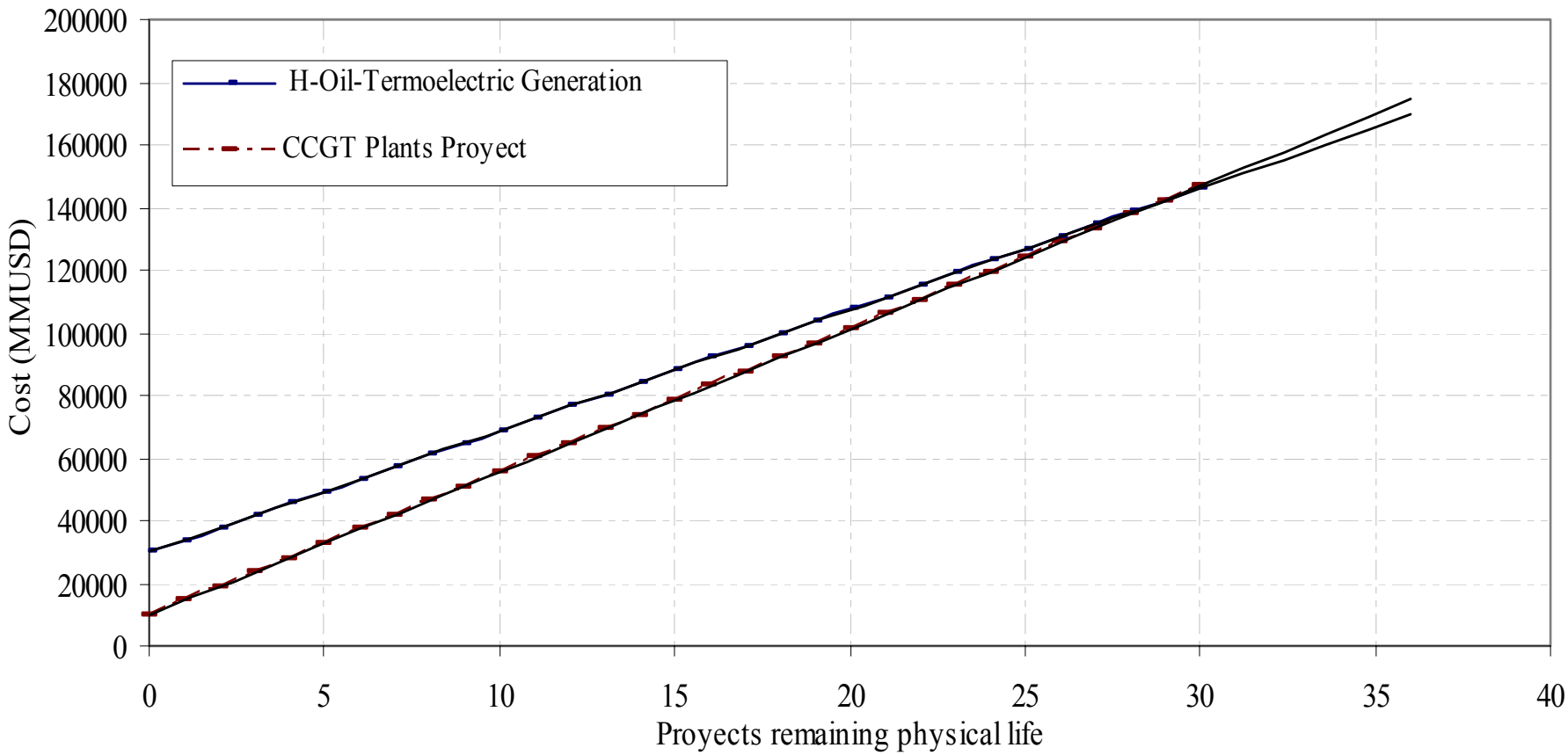
→ Observations: Full use of Mayan Oil in The Mexican National Refining System, to produce electric energy and low nitrogen and sulfur fuels, everything assuring energetic autonomy

H-Oil & CCGT Projects Cost (MMUSD)



Cost / Project	Fuel Oil	CCGT Plants
Infrastructure	29900	9750
Thermoelectric	19500	9750
H-Oil	10400	
Annual Costs	3874	4572
Operation Costs /year	683	601
Fuel / year	3191	3971

H-Oil-Thermoelectrics vs CCGT Plants

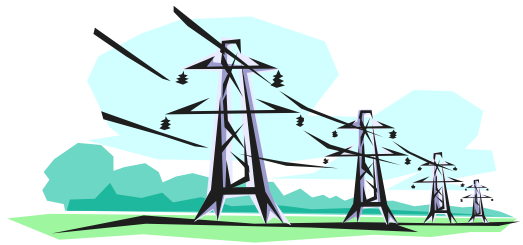


Amounts

The amount of investment to satisfy the demand of electrical energy to the 2011 by this propose is approximately 35 billion dollars (35,000 MMUSD).

Annually 5 billion dollars are invested in the electrical sector and in this year 14.3 billion dollars will be invested in PEMEX

Conclusions



A continuous investment in infrastructure of electrical generation is required. Although the electrical sector of the country currently satisfies the internal demand of energy, it will be doubled in the next decade

Alternative sources of energy and new oil fields needs to be explored. The national petroleum reserves tends to decrease. The export and price of petroleum are a decisive factors to balance the federal budget and the sale price of the Mexican mixture is frequently changing. Since almost 60% of the total crude petroleum production comes from the Northeast Marine region of the country (Cantarell), being this heavy oil, the NSR will be forced to process heavy oil.

Conclusions

The NSR has increased the percentage of heavy oil processed and therefore it requires the optimization of its infrastructure and the development and implementation of new technologies for a suitable processing of this kind of feedstock. The strategic exploitation of Mexico's energy resources will also have an impact on the national economy and we must prepare suitable technologies for the generation of required energy.

Diversified investments in the infrastructure for electrical generation: The use of a single energy source is not recommended . The price of Natural Gas and Petroleum are frequently changing and a supply shortage or significant price raises are not desirable.

The country demands increasing amounts of energy and it cannot expand using only natural gas as the only alternative resource available. The efficient processing of heavy crude oils can be one technological option that we could consider to exploit our energy resources. The proposal presented here indicates that in the future an intelligent investment is required for infrastructure in oil refining and generation of energy, creating a balance among its energy sources.