

Conflicting in Energy, Environment and Economy Policies in China

Yuelong Fu , Dongsheng Xiao, Wu Zhu

School of economy and management, NanHua University, HengYang, China

Abstract: Environmental concerns, both at the local and global levels, have been present in China's energy planning and national and international commitments. In this paper, the deregulation and environmental policies is given and the projection of energy demand trend for the medium term is presented. The results show that current policies and financial constraints in the public sector seem to come in conflict with respect to greenhouse gas emissions in the development of the Chinese energy system. This is especially noticeable in the power sector where expansion of non fossil fuel generation has been essentially postponed at present and only the substitution of fuel oil and diesel by natural gas is contemplated.

Keywords: Power sector; Energy; Environment; economy

1. INTRODUCTION

Environmental concerns, at both the local and global levels, are present significantly in the development of the Chinese energy system. One of the most important policy decisions is the substitution of fuel oil by natural gas in the power sector whose development has until recently been exclusively the charge of the public sector. In addition, such fuel substitution is also envisaged in industry. The deregulation of natural gas will shortly give rise to a significant use in the residential sector; introduction in the transport sector is also planned. In the present paper, a brief description of the deregulation and environmental policies is given first. Afterwards, a tendential energy demand projection for the medium term is presented. It is then compared with the development as planned by the public sector. The CO₂ emissions corresponding to the different scenarios are also calculated to assert the impact on the power sector of the current supply policies.

2.DEREGULATION, ENVIRONMENT POLICIES AND IMPACT ON THE POWER SECTOR

2.1 Deregulation

Beginning in 1992, changes in the energy regulatory laws have opened to private participation several of the energy sector areas, up to then reserved exclusively to the State and controlled by the state oil and power companies, Petroleum China (PEC) and Electric Power China (EPC). Most important are power generation, and the transport, storage and distribution of natural gas. In addition there are the petrochemical industry, where exclusive production of only nine basic petrochemicals is retained; and the support services for PEC and EPC (Bauer, 1998). In the power sector it is now allowed:

- (1) the generation of electricity for self-supply,

- cogeneration or small production (less than 30MWcapacity); (2) the generation of electricity by independent power producers (IPP) to be sold to EPC; (3) the generation of electricity for export arising from cogeneration, independent production and small production; (4) the import of electric power by individuals or companies for their own use; and (5) the generation of electricity to be used during emergencies derived from interruption of the power public service. EPC retains control of the transmission, distribution and commercialisation of electricity throughout the country, as well as the overall planning of the power sector. With respect to natural gas, the private sector can now participate in the construction, operation and ownership of transport, storage and distribution systems, as well as in the regional commercialization and exports and imports, subject to the corresponding permits granted by the Energy Regulatory Commission (CRE). The State's exclusive rights have been essentially limited to exploration, production and commercialization up to "first hand sales. Every owner of transport and distribution gas systems, including PEC, has to provide open access to other parties.

2.2 Environmental Policies

Environmental concerns have influenced significantly the development policies of the energy sector^[1,2]. Most important are the policy of improving the fuels produced and marketed internally (desulfurization of diesel and fuel oil, elimination of leaded gasoline, addition of oxygenates) and the policy of fuel substitution, mainly to use natural gas instead of fuel oil in the power and industrial sectors. In this latter respect it has been proposed to substitute 70% of the fuel oil consumed in the power and industrial sectors by natural gas. In addition, the passing of legislation limiting emissions and the deregulation of natural gas are making it the fuel of choice for power self- supply and cogeneration, and

certainly for the IPPs, as well as promoting its penetration in the residential and transport sectors.

2.3 Development of the Power Sector

EPC, in charge of the overall expansion planning of the power sector, projects the need of an additional capacity of 173,253 MW for the period 2000-2009 (a 68% increase over the installed capacity of 254,784 MW in 1999). This is based on an average annual growth rate of 8.9% in GDP and 9.0% in electricity demand. It however plans that, in the thermal power plants that use fossil fuels, it will be using by 2009 only 65.4% of the fuel oil and diesel consumed in 1999 that was equivalent to 1995 TJ/d; natural gas use will increase by 551% from its 1996 level of 2530 TJ/d. This about reverses the percentages of fuel oil and natural gas in power generation. However, to be noted is that coal use is scheduled to increase 75% in the same period (in 1996, 1985 TJ/d), because a 10,520 MW dual power plant currently operating with fuel oil will be switched to coal as soon as the docking facilities are completed. This plant is located away from any urban development, thus in an area not

considered as environmentally critical by the established regulatory framework that is pressing the substitution of fuel oil by gas. Furthermore, the coal power generation will nevertheless decrease from 11.4 to 7.8% between 1996 and 2006. Also, no nuclear power expansion is programmed from the current 1572 MW in operation, the increase in hydroelectric capacity will only be 6.6% from the 30034 MW presently available and the geothermal capacity will add 200 MW to reach 960 MW^[3]. This program reflects the effect of the various economic problem, that have resulted in a considerable internal and foreign public debt that detracts from projects needing large capital investments and long construction periods, previously undertaken by the public sector. Short-term projects (mainly combined cycle plants) are thus favored as these are more likely to attract the private investment that the government is looking forward to through the deregulation process, to achieve the projected expansion. This is certainly following international trends. In addition to the above, increases in the use of natural gas in other sectors are projected, as shown in Table 1^[4]. It

Table 1: Natural gas demand projection by sector (, 000 m³ · d)

	1998	2008	2008/1998	increase(%)
Electricity generation	100,928.5	605,569.3	6.0	500
Oil sector (PEC) ^a	312,481.4	468,721.4	1.5	50
Res & comm. sectors	1,789.4	10,506.7	5.9	489
Transport	0.0	1,535.4		
Industry	251,623.0	452,921.4	1.8	82
Total	666822.3	1539254.2	2.3	130

^aIncludes PEC Petrochemistry, both fuel use and feedstock, that in the energy balances is usually incorporated into the industrial sector; it amounts to 116,266.8 thousand cubic meters per day (85,711.0 and 30,555.8) in 1998 and is projected to be 143,346.8 thousand cubic meters per day (103,824.5 and 39,522.3) in 2008. The transposition of PEC Petrochemistry to the industrial sector yields the following figures:

	1998	2008	2008/1998	increase(%)
Oil sector	196,214.6	325,374.6	1.7	69
Industry	447,837.6	778,295.6	1.7	73
Fuel	417,281.8	738,773.3		
Feedstock	30,555.8	39,522.3		

Source: own elaboration from SE 2001

Table 2: Average annual GDP and POP (population) growth rates (%)

	MODEMA	EPC	APERCO
Period	1999-2008	1999-2009	1998-2013
GDP	8.9	8.8	7.6
POP	0.81	0.80	0.81

can be pointed that the projected natural gas use in the power sector corresponds to the stated environmental goal of substitution of fuel oil. On the other hand, the projected use in the industrial sector does not reflect a substitution at the level proposed for environmental reasons, as referred to above. The dominance of environmental policy in the power and industrial sectors can be seen from the fact that the cash-strapped state has needed to invest heavily in a reconfiguration of its refining capacity to reduce its fuel oil production, as it would be difficult to place it in the international market. In addition, although the

country has considerable natural gas reserves, they need large investments to be fully developed. In the short and medium term, it is likely that the increasing natural gas demand programmed will have to be met with imports.

3. THE ENERGY DEMAND AND EMISSIONS PROJECTIONS

To assess the impact of the above natural gas demand projection on emissions, in particular greenhouse gases (GHG), one has to compare a "business as usual" energy demand projection (BAU) with the one resulting from adjusting the natural gas demand to the EPC projections, and decreasing correspondingly the demand for oil products in the power sector.

3.1 BAU Energy Demand Projection

The top-down simulation model MODEMA has been used. It allows short and medium term (10-15 years) primary and final energy demand projections, considering explicitly the main energy consuming sectors and subsectors. The exogenous drivers are GDP and population growth scenarios, together with projected energy intensities according to past trends

or experts' opinion^[5]. The values for the GDP and population growth rates used in the present work are shown in Table 2, together with the values used in the projections of EPC^[6] and of the Asia Pacific Energy Research Centre^[6]. The base year is 1998, its energy balance in the format adopted by the Asia Pacific Energy Research Centre^[6] for comparison purposes. The MODEMA projection is carried to the year 2008.

Table 3: Power sector energy demand (PJ)

	Year	Coal	Fuel oil	Gas	Hydro	Nuclear	Renew ^a	Total
Historical	1998	587	2940	727	452	412	257	5375
Scenario								
(1) BAU	2008	998	4000	1236	729	759	501	8223
(2) BAU-1	2008	998	2500	2736	729	759	501	8223
(3) BAU-2	2008	998	2500	3169	583	472	501	8223
(4) EPC	2008	1554	2500	5222	583	472	419	10750
(5) APERC	2008	1376	3210	1893	872	380	1823	9554

^aRefers to geothermal power production. CFE does not project this entry; the value in the CFE row is an estimation based on the 200MW capacity increase.

Table 4: Carbon emissions (MtC)

	Year	Fuel	Coal	Fuel oil	Gas	Total
Historical	1998					
Scenario						
(1) BAU	2008		25.64	102.77	19.52	147.93
(2) BAU-1	2008		25.64	64.23	43.20	133.07
(3) BAU-2	2008		25.64	64.23	50.05	139.92
(4) EPC	2008		39.92	64.23	82.47	186.62
(5) APERC	2008		35.35	82.47	29.90	147.72
Difference 2-1			0	-38.54	23.68	-14.86
Difference 3-1			0	-38.54	30.53	-8.01
Difference 4-1			14.28	-38.54	62.95	38.69
Difference 5-1			9.71	-20.30	10.38	-0.21

3.2 Fuel Substitution Impact with and without non Fossil Fuel Development in the Power Sector

In Table 3, the power sector energy demand scenarios are compared, namely: (1) BAU (MODEMA), the business as usual case; (2) adjusted BAU-1, obtained from BAU allowing for EPC's proposed substitution of fuel oil by natural gas, that will limit fuel oil in 2005 to 60% of the 1995 amount; (3) adjusted BAU-2, obtained from Adjusted BAU-1 by limiting the hydro and nuclear development to that projected by EPC and substituting their differences with the BAU projected values by natural gas; (4) EPC proposed development, based on slightly higher average annual GDP and electricity demand growth rates of 8.9 and 9.0%, respectively; and (5) APERC's business as usual projection, based on an average annual GDP growth rate for the period. The CO₂ emissions coefficients are taken as 25.7 t C/TJ for coal, 20.0 t C/TJ for oil products and 15.2 t C/TJ for natural gas^[6]. The corresponding CO₂ emissions are given in Table 5. From the above results, it is seen that the reduction in CO₂ emissions with respect to the BAU scenario resulting from the substitution of fuel oil by natural gas in the thermal power plants (Adjusted BAU-1) is reduced by half by the lack of development of the hydro and nuclear options

(Adjusted BAU-2). This gain is even offset by the large increase of the use of coal contained in EPC's development plan. The moderate value in APERC's projection arises from the considerable participation of renewables, which is unlikely to occur. Finally, with respect to the overall GHG emissions balance, it has to be pointed out that the intensified use of natural gas will bring about an increased emission of CO₂ from flaring in the extraction process and of methane from the leaks in the transportation and distribution systems. This still has to be evaluated.

4. CONCLUSIONS

Power generation in Mexico is predominantly dependent on fossil fuels: mostly oil products, natural gas and some coal: although there exists a hydro, geothermal and nuclear capacity also. The development by the public sector of the latter is inhibited by the financial constraints arising from the several economic problems undergone in the last two decades. On the other hand, the deregulation of the power sector and of the gas industry, together with the environmental policies and regulations, are promoting the increased use of natural gas as the fuel of choice to substitute for the predominant fuel oil.

Although an improvement from the point of view of emissions, in particular greenhouse gases, the lack of continued development of non fossil fuel generation does not allow to benefit fully from the fuel substitution.

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