

# MEXICO

- Mexico's primary energy demand will grow annually at 2.3 percent, driven mainly by increased demand for oil and natural gas in the transport and industrial sectors.
- Steady demand growth and depleting energy reserves will decrease the economy's net energy export position from 59 percent in 2002 to 9 percent in 2030.
- Continued reforms in the regulatory policies of the energy sector may contribute to improvement in the economy's domestic supply potential.

## RECENT ENERGY TRENDS AND ENERGY POLICY

Mexico's final energy consumption has increased from 91.6 Mtoe in 2002 to 98.3 Mtoe in 2005 at an average annual growth rate of 2.4 percent, as a result of strong industry expansion and improvement in living standards. The transport sector accounted for the largest share in total energy consumption at 65 percent, followed by industry at 20 percent. Oil, the primary energy source, has accounted for two-thirds of total final energy consumption over the period 2002 to 2005.

The economy has indigenous energy resources of oil, natural gas and coal. Mexico's crude oil requirements have historically been met by domestic production, however, as the economy's demand for petroleum products continued to grow, the economy's refinery utilisation ratio reached 97 percent, promoting the importation of petroleum products to meet domestic demand – 15.7 million tonnes of petroleum products were imported and 5.2 million tonnes were exported in 2005. In the case of natural gas, 35.6 Mtoe was produced domestically in 2005, however, in the north-western area 9.0 Mtoe was imported from the US since there is currently no domestic pipeline infrastructure. Similarly, 1.2 Mtoe of coal was imported in 2005 – the coal import dependency of the economy being 20 percent.

Mexico is one of the world's major non-OPEC oil producing economies and exports of crude oil increased from 97.9 million tonnes in 2002 to 102.8 million tonnes in 2005, of which approximately 80 percent was exported to APEC economies, predominantly the US.

However, like any other finite resource, oil reserves are depleting gradually. As a result of early depletion of oil reserves, the government has been prompted to intensify investments in the upstream oil sector, some examples of which are the development of the Chicontepec Oil and Marine Building Programmes in the Gulf of Mexico.

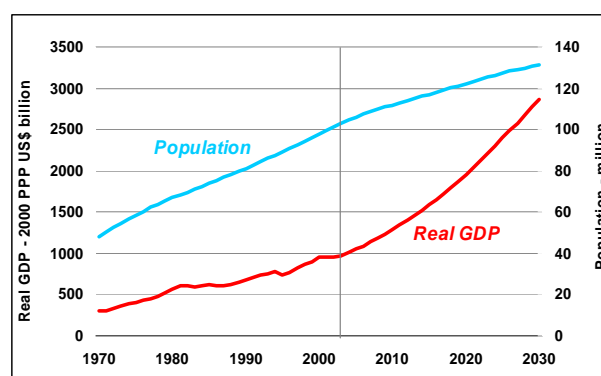
The economy also has plans to restructure the energy sector and diversify energy source away from oil through the utilisation of coal and renewables.

To ensure entry of investors and expand investments in the energy exploration and development, the government has made modifications to the legal framework and introduced the Energy Sector Program 2001-2006, aimed at liberalising energy markets to augment investment capacity, foster competition in the energy market, and enhance energy quality and supply.

## ENERGY DEMAND DRIVERS

Mexico's economy is expected to grow at an average annual rate of 4.0 percent over the outlook period. Industry is the second largest energy consumer in Mexico after transportation and is projected to be supported by strong industrial GDP annual growth of 3.7 percent despite the narrowing gap in energy conservation due to the saturation of modern technologies within the industry sector through the North American Free Trade Agreement (NAFTA).

Figure 62 GDP and Population



Source: Global Insights (2005)

Population is expected to grow annually at 0.9 percent, lower than growth rate of 1.9 percent over the previous two decades with total population increasing from 101 million in 2002 to 131 million in 2030.

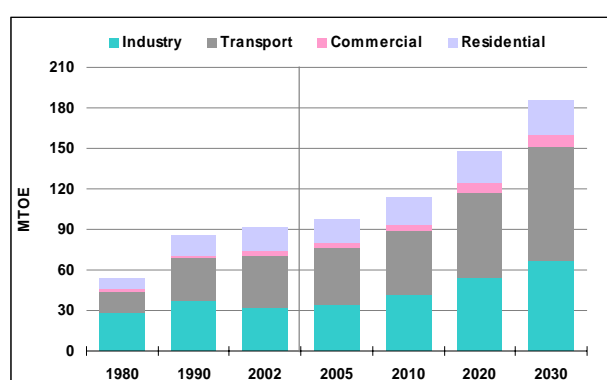
Over the outlook period, rising income and improvement in living standards will increase the proportion of urban dwellers, projected to increase from 75 percent in 2002 to 83 percent in 2030.

## OUTLOOK

### FINAL ENERGY DEMAND

Mexico's final energy demand is expected to grow at 2.5 percent per year over the outlook period, which is similar to the annual growth in the previous two decades of 2.5 percent. The transport sector is projected to account for the largest share at 46 percent, followed by industry (36 percent), residential (14 percent), and commercial (4 percent).

Figure 63 Final Energy Demand



Source: APERC Analysis (2006)

### Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 2.7 percent until 2030, faster than its average annual growth of 0.6 percent over the past two decades. Strong expansion in the industry sector of 3.7 percent per year and emphasis on exports to North America will lead to the faster projected growth in energy demand. Since 1990, energy efficiency improvements (for example increased use of continuous casting in steel making) and structural changes in Mexico's industry have played an important role in reducing industrial energy consumption. From 1990-2002, industrial energy consumption in Mexico fell at an average rate of 1.2 percent per year, conversely the value-added of industrial sector grew by 2.5 percent. The decoupling of energy consumption and income in the industrial sector has resulted mainly from the drastic reduction in energy intensity of Mexico's industry, particularly in petrochemicals, iron and steel, sugar, cement, and paper and pulp production.<sup>74</sup> Further energy efficiency improvements and changes in the industrial structure are expected to continue to reduce energy intensity at

a moderate pace of 1.0 percent per year, reaching 100 toe per US\$ million in 2030 from 132 toe per US\$ million in 2002.

Over the outlook period, electricity is projected to account for the highest growth in industrial energy demand, increasing at an average annual rate of 3.8 percent. Electricity demand will surpass that of petroleum products as the leading energy source, accounting for 40 percent of industrial energy demand in 2030. The additional demand for electricity is expected to be met by an influx of independent power producers (IPPs) in the manufacturing sector. By contrast, the demand for petroleum products is projected to grow slowly at 2.0 percent per year with a decreasing share, from 37 percent in 2002 to 31 percent in 2030, following the historical declining trend for fuel oil. The share of natural gas is projected to remain fairly constant at 27 percent over the outlook period. The switch to natural gas in the industrial sector will be driven by stricter environmental regulations that discourage the use of fuel oil and coal. Coal demand is projected to decline at 1.9 percent per year as energy efficiency improvements continue to be implemented in the iron and steel industry. Industrial coal consumption decreased at 3.5 percent per year between 1990 and 2002.<sup>75</sup> Renewable energy demand in industry is also projected to decline at 0.8 percent per year, mainly because of reduced demand for biomass. Biomass, in the form of sugarcane bagasse, is experiencing supply shortages as the sugar industry is faced with increasing international competition from fructose imports. Sugarcane bagasse is gradually being replaced by high-quality modern fuels.

### Transport

Mexico's transport energy demand is dominated by the road transport sub-sector, accounting for as high as 91 percent of total transportation energy demand in 2002. Due to the absence of a mass transport railway system, urban dwellers have to rely on road transport including private vehicles, buses and taxis. Integration to the North American economy as a result of the NAFTA in 1994 has led to a substantial increase in diesel requirements for

<sup>75</sup> According to Ozawa et al. (2002), the reduction of coal use would be explained by structural changes and energy efficiency improvement of iron and steel industry: the closing of inefficient open hearth furnace by 1992; the increased use of the continuous casting (from 10 percent in 1970 to 85 percent in 1996); the implementation of new technologies for direct iron production; and the increased utilisation of coke oven and blast furnace gases for on-site electricity generation. In addition, Mexico has a relatively high share of electric arc furnace at about 60 percent of crude steel production, compared with some 40 percent in the US, 45 percent in Korea, and 20 percent in China.

<sup>74</sup> Aguayo and Gallagher (2005)

freight trucks. Development of an automobile industry has reduced the price of passenger vehicles, and spurred the growth of vehicle ownership.

Over the outlook period, the transportation energy demand of Mexico is projected to grow at an annual rate of 2.8 percent. The projected growth would come from road transport, which will account for about 92 percent of the incremental growth in total transport energy demand, with the remainder from air transport representing around 8 percent. With the continued growth, per capita transportation energy demand is projected to grow from 0.38 toe in 2002 to 0.64 toe in 2030, lower than the APEC average of 0.42 toe in 2002 and 0.67 toe at 2030.

By fuel type, gasoline demand is expected to continue to grow robustly at an annual rate of 2.6 percent a faster rate than the previous two decades at 2.3 percent per year. Mexico's integration to the economic activities of North America will further boost the requirements for freight transport, which will in turn result in diesel demand growing at 2.7 percent over the outlook period. Jet kerosene demand for air transport will increase at an annual rate of 3.3 percent – a faster rate than the previous two decades at 2.7 percent per year. Again, integration to the North American market will spur the growth of air transport for both passenger and freight volumes.

#### Residential and Commercial

Mexico's residential energy demand is driven by increasing income, size of household and ownership of appliances, level of electrification and differences in energy services between urban and rural areas. The energy demand of the residential sector is projected to grow at 1.4 percent annually over the outlook period. Demand for natural gas is expected to grow at the fastest rate of 6.0 percent per year, with the share increasing from 3 percent in 2002 to 12 percent in 2030. This is as a result of government efforts to substitute oil as well as the replacement of LPG with natural gas. By contrast, the share of LPG will decrease from 42 percent in 2002 to 37 percent in 2030, but will maintain the largest share throughout the outlook period. However the demand for LPG is expected to grow at an annual rate of 0.9 percent, which is slower compared with the 5.0 percent annual growth rate in the past three decades. Electricity demand is expected to grow at the same rate as that of electrification at 3.0 percent per year, with the share of electricity increasing from 19 percent in 2002 to 29 percent in 2030, to account for the second largest share in total residential energy demand. The replacement of biomass with commercial fuels because of increasing

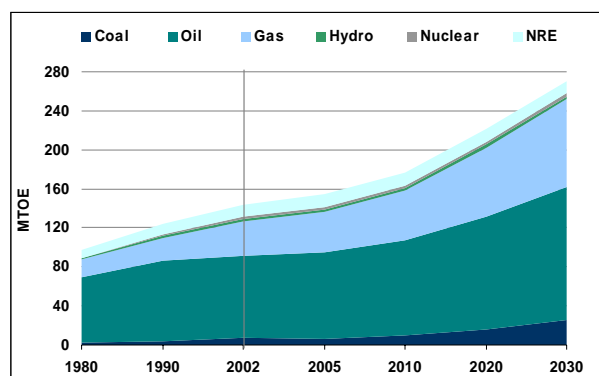
environmental and health concerns, will result in a decrease in the share of combustible renewables (mostly fuel wood), and will account for a 21 percent share of total residential energy demand in 2030. As fuel wood is never replaced entirely, even in households that have been using LPG for many years, the demand is projected to decline gradually at a rate of 0.4 percent annually over the outlook period.

Over the outlook period, commercial energy demand is expected to grow at 3.0 percent annually, moving in line with the value added for the services industry growth of 3.9 percent per year. As in the residential sector, natural gas demand is expected to grow the fastest, making up about 14 percent of total commercial energy demand in 2030. Demand for natural gas is expected to grow at 6.0 percent annually throughout the outlook period. Conversely, the share of LPG in total commercial energy demand is projected to decline from 47 percent in 2002 to 35 percent in 2030 as LPG will be replaced by natural gas and electricity. Electricity is expected to account for the largest share of total commercial energy demand at 44 percent after 2014.

#### PRIMARY ENERGY DEMAND

Despite an almost two-fold increase in primary energy demand, oil will maintain the dominant share over the outlook period. However, the total share will decline from 58 percent in 2002 to 51 percent by 2030.

Figure 64 Primary Energy Demand



Source: APERC Analysis (2006)

Major growth in demand for coal and natural gas is expected at 4.2 and 3.3 percent respectively. The increasing share of coal will be due largely to the government's policy of fuel diversification in electricity generation, to reduce the economy's high reliance on natural gas. Despite having considerable natural gas reserves, the demand for natural gas will have to be met by imports. Therefore important investments will have to be made to explore and develop new natural gas fields. Nuclear is expected

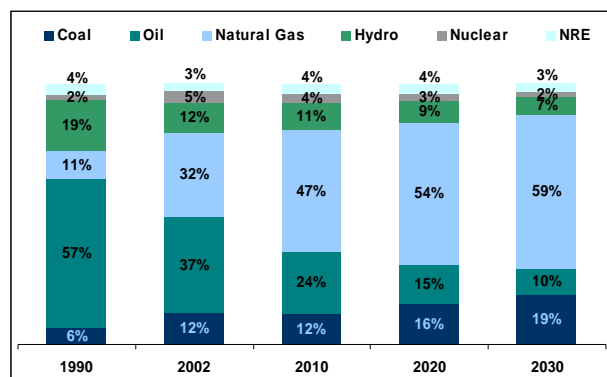
to maintain the current level over the outlook period. The share of renewables in primary energy demand is projected to decrease from 8 percent in 2002 to 5 percent in 2030 as a result of the substitution of biomass for other forms of commercial energy and difficulties in financing renewable energy projects.

### ELECTRICITY

Electricity demand is projected to grow at 3.6 percent over the outlook period, with the share of gas and coal in the electricity generation mix expected to increase. Electricity generation is projected to reach 505 TWh in 2030 with 59 percent of electricity generated from gas, 19 percent from coal, 10 percent from petroleum, 7 percent from hydro, and 3 percent from new and renewable energy. No new nuclear capacity will be added during the outlook period thereby reducing the share of nuclear from 5 percent in 2002 to 2 percent in 2030.

The share of oil-fired electricity generating plants is projected to decrease to 12 percent of total installed capacity in 2030 from 37 percent in 2002. In contrast, the share of natural gas will increase from 25 percent in 2002 to 52 percent in 2030. Likewise, the share of coal will increase by 8 percent over the same period. New and renewable energy will grow at 4.6 percent annually between 2002 and 2030, with wind and biomass-based electricity generation projected to respectively reach 2.2 TWh and 7.5 TWh in 2030 from 4.4 MWh and 470 MWh in 2002.

Figure 65 Electricity Generation Mix

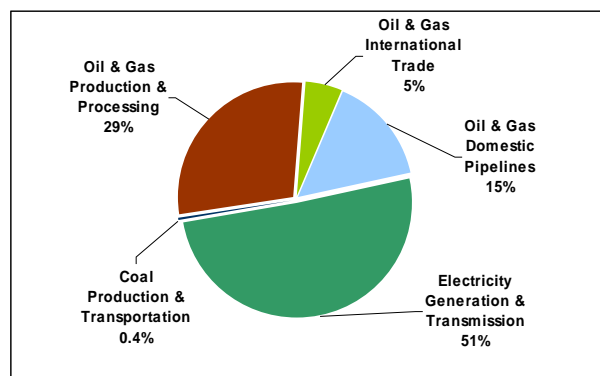


Source: APERC Analysis (2006)

### INVESTMENT REQUIREMENTS

The investment required to finance the economy's future energy infrastructure development over the outlook period is projected to be between US\$172-228 billion. The majority of which will be used for the build up of electricity generation and power grids expansion, and also for domestic oil and gas industries developments.

Figure 66 Investment Requirements

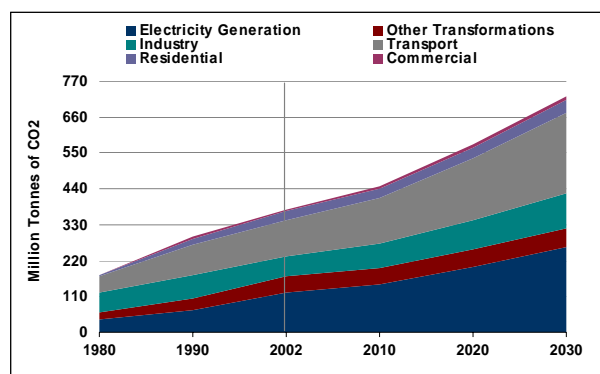


Source: APERC Analysis (2006)

### CO<sub>2</sub> EMISSIONS

The continued dominance on fossil fuels in the economy's electricity generation mix and the growth in petroleum demand of the transport sector will generate a total of 724.1 Million tonnes of CO<sub>2</sub> in 2030.

Figure 67 CO<sub>2</sub> Emissions by Sector



Source: APERC Analysis (2006)

## MAJOR ISSUES

### UPSTREAM OIL INDUSTRY DEVELOPMENT

Mexico's proven oil reserves will eventually deplete as indicated by the low reserves to production ratios observed in the past decade<sup>76</sup>, which will subsequently decrease oil exports over the outlook period. Therefore, a strong need for additional investment in exploration and development of new acreage to maintain the economy's net oil export position is required. A major barrier however is the economy's constitution which restricts the exploitation of natural resources to the national oil company that has in turn limited both foreign and private sector participation in the industry. To

<sup>76</sup> PEMEX reports Mexico's oil reserve to production (R/P) ratio at 38 years, while the BP Statistical Review of World Energy 2006 puts the R/P ratio at 10.0 years.

address this concern, Mexico aimed to reform the energy sector through amendments to the constitution, which would allow private and foreign participation in the oil industry, including natural gas. However, the plan was deferred due to insufficient congressional support to make the necessary changes.

#### NEED FOR A LONG-TERM ENERGY POLICY

The fuel choice dilemma for new thermal power plants should be addressed in parallel with the long-term national energy strategy. Therefore the establishment of a complex energy strategy is necessary to overcome hurdles for future energy supply and environmental protection which could benefit the Mexican economy and the society as a whole.

In addition, Mexico's projected high demand for natural gas and decreasing supply of pipeline gas from the US would precipitate the need to secure future natural gas supplies through the establishment of LNG import facilities.

Likewise, to address the growing projected demand for steam coal for electricity generation could be addressed by increasing both domestic coal production and coal imports.

Most Mexican cities have air pollution problems and the land transportation sector is the main contributor to this problem.

### IMPLICATIONS

Growing energy import dependence will complicate the economy's position in the global energy market. Mexico will become a significant importer of LNG and coal in the APEC region. However, decreasing oil exports, will add to the overall call on oil and natural gas in North America.

In the long-term, the government's dependence on oil revenues will prove to be a major concern, particularly if revenues cannot keep up with increased spending in health, education, and infrastructure, that is necessary to maintain and improve Mexico's standard of living, as currently non-oil related fiscal revenue makes up only about 12 percent of Mexico's GDP.

### REFERENCES

- Aguayo, F. and Gallagher, K.P. (2005). *Economic Reform, Energy, and Development: the Case of Mexican Manufacturing.* Energy Policy 33.
- APEREC (2005). *APEC Energy Overview 2005.* Tokyo.

EDMC (2002). *APEC Energy Database.* Energy Data and Modelling Center, Institute of Energy Economics, Japan. Website: [www.ieej.or.jp/apec](http://www.ieej.or.jp/apec)

North American Natural Gas Vision (2005). *North American Energy Working Group, Experts Group on Natural Gas Trade and Interconnection.* January 2005. 119 p.

Ozawa L., Sheinbaum C., Martin N., Worrell E., and Price L. (2002). "Energy Use and CO<sub>2</sub> Emissions in Mexico's Iron and Steel Industry." *Energy* 27.

PEMEX (2006). *Petróleos Mexicanos.* Website: [www.pemex.com.mx](http://www.pemex.com.mx).

SENER (2006). *Secretaría de Energía de Mexico.* Website: [www.sener.mx](http://www.sener.mx).