# Techno-economic and Environmental Assessment of Power Capacity Expansion in Iran

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**Abstract**

A review of Iranian power sector development during the recent three decades reveals that the average annual growth rate of installed capacity and gross electricity generation are 7.0 and 8.3 percent, respectively. In line with the generation growth, the total consumption of fossil fuel energy carriers including natural gas (NG), fuel oil, and gas oil in this sector has increased by 8.5 percent annually and also the $CO_2$ emissions has increased by 8.3 percent.

The main objective of this paper is to determine the deviation of historical development from a hypothetical and possible optimal scenario. In fact, this paper measures the gap between the actual power sector development and what could be happened ideally from techno-economic and environmental perspectives. MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impacts) as a bottom-up energy supply optimization model is employed to assess the appropriate technology options from 1984 till 2014. In this model, the total costs of electricity supply system are considered as the criteria to find the optimum condition. Then, model implementation results are compared with actual statistics to specify the rate of deviation from optimum scenario.

Fig. 1 compares the generation mix and conversion efficiency of thermal power plants in optimal and actual condition. The optimum condition shows that from 2005 onwards combined cycle units has the largest share in power generation and in parallel with this increase, the share of gas turbines has been reduced. Moreover, wind turbine and gas engine could achieve 2% and 5% of total gross production, respectively; this is while in reality the share of these two technologies in total production is about 0.7 percent in 2014. Based on model results in 2014, the share of combined cycle, steam power units and gas turbine in power generation could be of 50, 22 and 4 percent. Moreover, 9 percent of total electricity gross generation in the same year was accomplished by utilization of coal-fired power plants. However, according to the official statistics for the same year in actual condition, the corresponding shares were as follows: combined cycle 35%, gas turbine 27% and steam turbine 31%.

The other findings of this article are as follows: 1- the average efficiency of thermal power generation in actual condition is 4.4% lower than the ideal scenario in 2014, 2- non-optimal path has led to the loss of 90 billion cubic meters of natural gas equivalent and additional emissions of 400 million tons carbon dioxide over the past three decades, and 3- non-optimal pathway has imposed an additional cost of $19 billion over the entire study period.

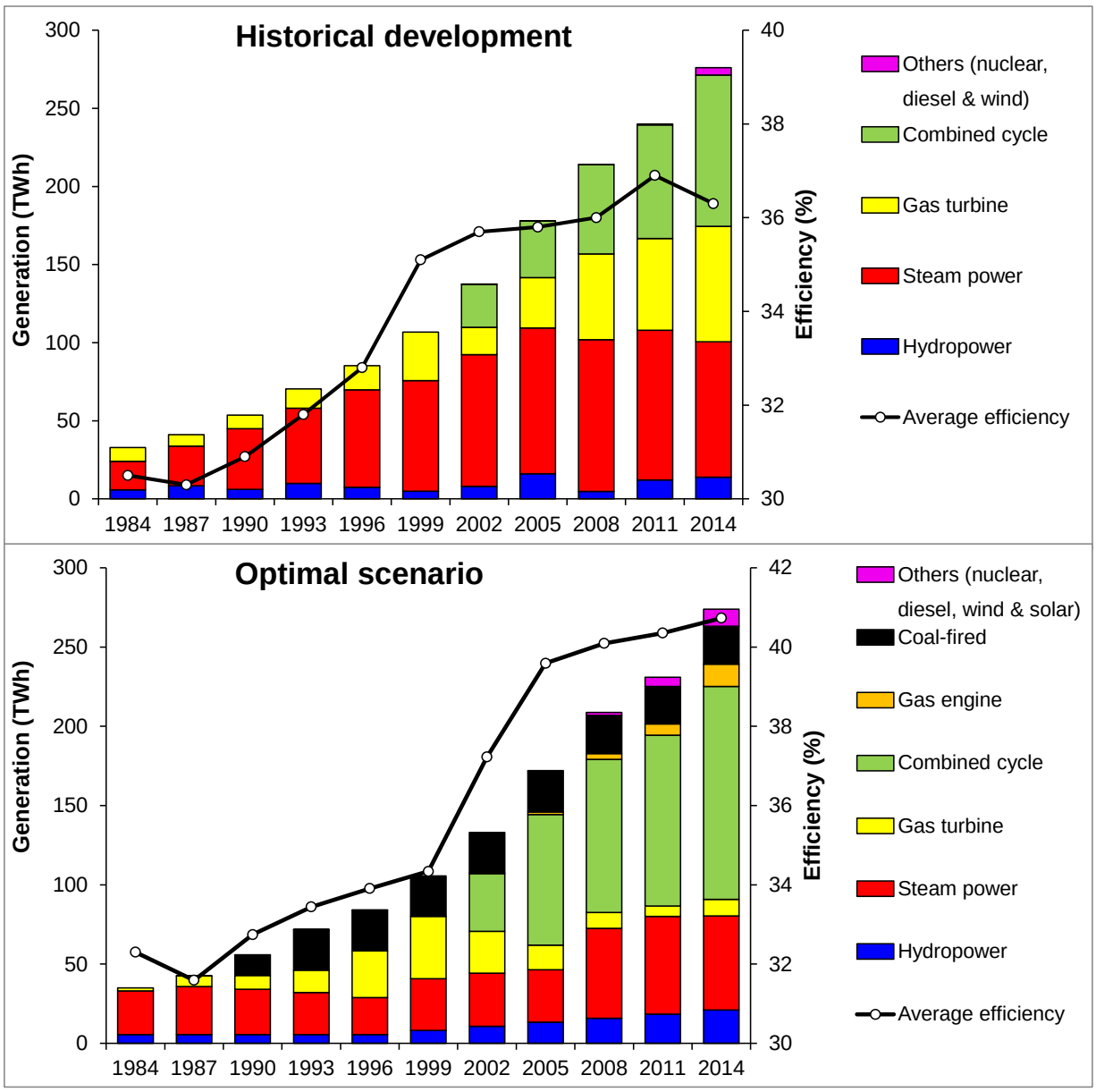


**Fig. 1.** Generation mix and average efficiency of thermal units in different conditions