

Outcome of the modelling results and policy review of Clean Coal Technology in Japan

NITI Aayog has used multi-variant projection of ARIMA model to project overall energy demand and power generation mix scenario of the Japan. The reference case and advanced technology scenario has been created for the above projection. The reference case is assumed as current policy intervention by Government of Japan and advanced technology scenario has been assumed as advanced technology and energy efficiency penetration in Japan energy sector.

Increase in Coal Based Generation in Overall Power Generation Mix: Japan's CO₂ Emissions were about 1.31 billion tons in fiscal year 2013. About 270 million tons of emissions were derived from the coal-fired power generation. Although Japan's coal-fired power generation has the world's highest level of efficiency, it still emits about twice the amount of CO₂ as compared to LNG-fired power generation.

However, due to Great East Japan Earthquake and consequential shutdown of nuclear power plants in 2011, coal based power plant will play a major role in Japan energy mix. , the coal based power generation in Japan economy from 2010 to 2015 has been increased from 25% to 31.6%. The LNG based generation and hydro & pumped storage generation has been increased from 29.3% to 44% and 8.5% to 9.6% respectively for the same period. The nuclear generation has been dropped 28.6% to 1.1% from 2010 to 2015. However, renewable energy has been increased from 1.1% to 4.7% from 2010 to 2015.

Coal Based Power Generation Scenario in Power Generation Mix: As per, Ministry of Economy, Trade & Industry (METI), Japan coal based generation will continue to contribute 25 to 30% till 2030 in the overall energy mix of the Japan. Further, as per NITI Aayog projection by using ARIMA model, the coal based power generation will reduce approximately 34% to 25% from 2014 to 2030 and 34% to 22% in advanced technology scenario under overall power generation mix.

Clean Coal Technology Share: Currently, Japan has 4.35 GW (14%) sub-critical, 12.5 GW (39%) super-critical and 15.3 GW (48%) ultra-super critical coal based power plant. In Japan, sub-critical technology and super critical technology based power plant was installed during 1960 to 2000. After 2000 onward, Japan is either installing new capacity under ultra-super critical technology or replacing old coal based power plant by replacing with ultra-super critical technology. For example, ISOGO power plant technology was replaced with ultra-super critical technology. Now, the ISOGO Power Plant has achieved 0.001 ppm SO_x level & 0.06 ppm NO_x level in 2015, which is world lowest emission level in coal based power plant.

Advanced technology in Japan: Japan is extending its research & development in advanced ultra-super critical technology (A-USC), integrated coal gasification combined system (IGCC) technology and integrated coal gasification fuel cell combined system (IGFC). Japan is likely to implement A-USC by 2020, IGCC by 2030 & IGFC by 2040 in coal based power industry.

Further, Japan has two level of environmental obligation i.e. under local government, local environmental obligation. The local environmental obligation covers de-sulfurization (SO_x), de-nitrification (NO_x) & dust collection (Particulate Matters-PM) from emissions of the coal based power plant. However, the global environmental obligation is more concern about reduction of the CO₂ emission. Japan is meeting both obligation by efficiency improvement in its coal power plant by implementing ultra-super critical technology and Japan is also planning to adopt advanced future technology (under R&D phase like A-USC, IGCC & IGFC) for meeting these obligations in the future.

IGFC + Carbon capture: Japan has started a demonstration project of oxygen-blown IGFC + Carbon capture. The name of the project is Osaki Coolgen. It has been stated that IGFC has net thermal efficiency about 55%, which is more than 15% of USC (41%). The project will utilized sub-bituminous coal and CO₂ will capture through oxygen-blown gasification process. The project period is 2012-2021.