



Daya Bay nuclear station supplies roughly a quarter of Hong Kong's power needs while, left, Hongkong Electric's Lamma facility is one of the coal and gas-fired plants helping meet demand.

FIGURING THE WAY UP THE POWER PYRAMID

My article last week described the desire to meet the 2050 zero carbon initiative and suggested wind power as one way to increase the use of renewable energy.

To provide a reliable and economical supply, the power plant fuel mix composition takes the form of a pyramid, with the large base load provided by nuclear or coal plants topped by turbine plants burning natural gas for the smaller peak load.

The order in which plants go on or off the grid depends on the plants' startup to full load time period.

To start and stop a nuclear plant we need to plan weeks ahead as it takes days to start and bring it to supply power, take the necessary safety precautions, and then bring the plant to stable thermal conditions.

Coal and oil plants take the better part of a day to start and stop as rushed starts and stops will cause undue thermal stresses to the boiler, which will shorten the life of the plant.

Gas turbine plants – burning natural gas – can start and stop within minutes and would be ideal for peak supply, but to attain a higher thermal efficiency to offset the higher fuel costs, the hot exhaust gases are usually led to a waste-heat boiler to extract more heat energy to drive another steam turbine to produce extra power.

This tandem system of gas turbine and waste heat boiler brings the operational costs of the natural gas burning plant closer to that for coal and oil plants.

A bypass exhaust duct system allows instant starts and stops without involving the boiler.

To keep operational costs affordable for consumers, the power pyramid schedules the nuclear and some of the coal or oil plants to operate continuously, leaving natural gas plants to cater for the varying demands in the daily demand cycle.



This cycle for a place like Hong Kong, with little industrial activity, has peaks in mid-morning and mid-afternoon, when most people are at work and the air-conditioning load draws a huge demand from the power grid. In the evenings, the power demand drops significantly and some plants can be switched off.

Renewable energy that is heavily dependent on the weather cannot be regarded as a reliable form of supply, so in order to fit into the supply periods, it can only be used to supplement the part nearer the top as alternatives to gas turbine plants.

Switching off coal or nuclear plants will be much more involved and repeated rapid switching will affect their life cycle and increase operating and maintenance costs.

As an example, Germany banned the use of nuclear energy and greatly increased the proportion of renewable energy as base load. This upset the traditional power pyramid and significantly increased power costs.

Fortunately, Germany imports nuclear energy from France.

Renewable energy costs are often heavily subsidized to encourage their use, but the social costs are high.

The small potential of renewable energy in Hong Kong prevents us from falling into this trap, but we must plan our transition to reduce fossil fuel burning until technology can significantly increase the power density of solar and wind power for our continuous application.

Veteran engineer Edmund Leung Kwong-ho casts an expert eye over Hong Kong's iconic infrastructure