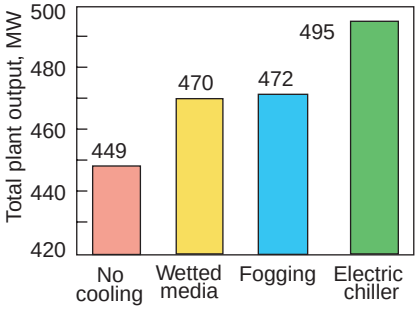
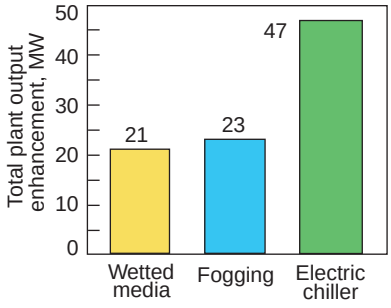
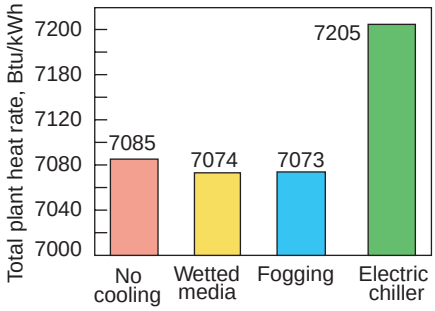
2. Impact of cooling method on total plant output



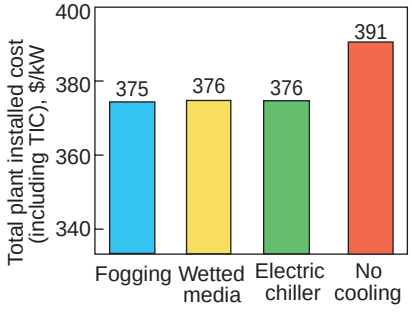
3. Gain in GT output for alternative cooling technologies



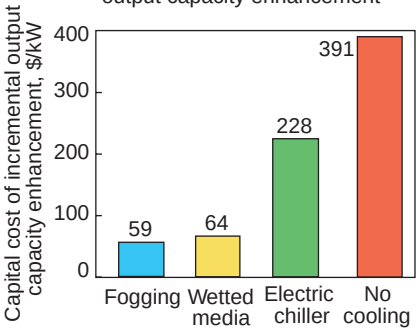
4. Impact of cooling method on plant heat rate



5. Impact of cooling technology on total plant installed cost



6. Capital cost of incremental output capacity enhancement



to 42F, independent of ambient wet-bulb temperature. It works this way: Inlet air flows across cooling coils within which either chilled water or refrigerant is circulated. The mechanical chillers used in these systems usually are driven by electric motors or steam turbines.

Cold water can be supplied directly from a chiller or from a thermal energy storage (TES) tank containing ice or only chilled water. TES typically is specified when inlet-air cooling is required for a limited number of on-peak hours, because it reduces the chiller plantÕs installed capacity requirements and overall capital cost. Also, TES allows the plant to export maximum power on peak because the TES system is charged at night using off-peak electricity.

The primary disadvantages of mechanical refrigeration compared to evaporative cooling technologies: It has a higher capital cost, a larger footprint, and a higher parasitic power load. The impact of its power requirement may increase overall plant heat rate if TES is not used.

Absorption cooling uses thermal energy (steam or hot water) to drive the cooling process and requires much less electric power than mechanical chillers. Absorption systems can be used to economically cool inlet air to about 50F. These systems can be used with or without TES.

Chillers can be single- or double-effect technology. The single-effect chiller uses hot water or 15-psig steam. For steam, the requirement is 18 lb per ton of refrigeration, presented as 18 lb/RT. The double-effect chiller uses less steam (10 lb/RT) but needs the steam at higher pressure (115 psig). Major disadvantage of absorption chilling is that its capital cost is higher than that for mechanical refrigeration systems. Furthermore, in combined-cycle applications the absorption system may decrease the output of the steam turbine/generator if some of its steam is diverted to the chiller.

Hybrid systems incorporate some combination of mechanical refrigeration, absorption cooling, and/or TES systems. Such systems are optimized for a specific plant based on the power demand, time-of-day electric prices, and the availability of thermal energy.

LNG vaporization systems are useful for combined-cycle plants located near a liquefied natural gas (LNG) facility. LNG is vaporized for pipeline transport by removing heat from the GT inlet air.

Case study

To illustrate the impact of wetted media, fogging, and electric chillers on combined-cycle plant performance, consider the following example for a unit located in Houston. It consists of two identical frame GTs, each rated 170 MW (gross), one 172-MW (gross) steam turbine, and a total plant parasitic load of 11.5 MW. Net plant production at ISO conditions is 501 MW.

When the ambient temperature in Houston is 95F