NOAA scientists calculate weather effects of power parks

Giant power plant installations planned for the future may generate weather as well as electricity, with thunderstorms, fog, increased rainfall, and whirlwinds among the possible meteorological "side effects," two scientists with the National Oceanic and Atmospheric Administration (NOAA) believe.

Power parks, where plants generating as much as 50 billion watts would be concentrated in a single location, are contemplated by some as a means of satisfying the nation's energy needs.

Such energy centers would dissipate vast amounts of waste heat into the atmosphere, with a variety of effects on local weather possibly resulting, according to Drs. Steven R. Hanna and Franklin A. Gifford of NOAA's Environmental Research Laboratories.

The two researchers, point out that power utility companies and government agencies are studying several sites as potential power parks that would generate 10 to 50 billion watts of usable energy.

In producing that energy, however, as much as 100 billion watts of waste energy would be dissipated probably through some type of cooling tower.

If towers for such a power center were spaced around an area of 100 kilometers (about 40 square miles), the production of waste heat would amount to 1,000 watts per square meter (about 10.8 square feet)–three times greater than the average solar energy reaching the outer edge of the earth's atmosphere, and nearly equal to the energy released in a thunderstorm.

The Commerce Department scientists believe a heat release of that magnitude could generate thunderstorms, or act as a triggering mechanism in areas where thunderstorms frequently occur naturally. The cooling towers would add moisture to the atmosphere, and their thermal plumes would act like a hill or mountain forming a barrier to air flow and causing abrupt lifting of air.

The combined effects of moisture addition and buoyant lifting of air would increase precipitation and thunderstorms.

No existing power facility releases anywhere near 100 billion watts of heat, but there are comparable stationary heat sources that the NOAA scientists believe can provide clues to the meteorological effects of giant power parks.

The Surtsey volcano, which emerged from the sea south of Iceland in 1963, released an estimated 100 billion watts of heat from an area less than a square kilometer (about .39 square miles). A permanent cloud visible 115 kilometers (about 70 miles) away formed over the volcano, and waterspouts developed below the bent-over plume.

Large bush fires in Australia, which produce comparable amounts of heat, are frequently crowned by towering cumulus clouds, and changes in meterological conditions associated with fires seem similar to those associated with severe thunderstorms and tornadoes.

In an experiment reported in 1964, one researcher set up 100 oil burners to induce cumulus convection. The total heat release of 700 million watts generated cumulus clouds and dust devils.

Under favorable conditions, the static firing of a Saturn V booster rocket also can initiate convection in the atmosphere. On one occasion, on a day when cumulus clouds and rain showers were occurring naturally, a cumulus cloud with a central, donut-shaped area that revolved cyclonically, formed above the rocket.

Finally, Hanna and Gifford point to the well known "heat island" effect of urban areas, which may contribute to altered rainfall downwind. The total heat output of a 10 to 50 billion watt energy center would equal that of a large city, but would be much more concentrated geographically.

Intense heat sources may also generate vortices in the atmosphere. A source of rising warm air could draw air toward it, concentrating and intensifying any slight spin occurring naturally in the surrounding air.

Dust devils, waterspouts, and tornadoes are thought to be formed in this way. Hanna and Gifford add that whirlwinds were caused by fire bombing during World War II, and are often observed over fires in the lee of mountain ridges in the Pacific Northwest.

Using an existing formula that relates the vertical speed of a rising column of air to the velocity of air moving horizontally past it, the NOAA scientists calculated that a cluster of 20 cooling towers within a radius of 500 meters (1640 feet) could generate a vortex.

"Wet" cooling towers – those that eject moisture as well as heat – would also produce ground fog downwind. Hanna and Gifford estimate that fog would occur about 66 percent of the time 20 kilometers (about 12 miles) downwind of the cooling towers and 21 percent of the time 100 kilometers (about 62 miles) from the site.

If winds are equally probable from all directions, this means that a given spot 20 kilometers (about 12 miles) away would have ground fog four percent of the time.

Furthermore, some of the moisture ejected by the towers would sink to the ground nearby, forming a fairly dense fog within several hundred meters of the towers, requiring the location of cooling towers with respect to highways to be considered.

Water in the form of droplets would fall in a ring around the cooling towers between two and four kilometers (one and two and one half miles) away, causing an increase in rainfall of 0.4 centimeters (0.16 inches) per year.

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Their paper, "Meteorological Effects of Energy Dissipation at Large Power Parks," appeared in the Bulletin of the American Meteorological Society.