centers were responsible for 1.5% of the total electricity consumption in the United States. Likewise, data centers were estimated to be responsible for .5% of greenhouse gas emissions in the United States in the same year. The amount of greenhouse gas emissions from data centers is also expected to rise in the future. For example, it is projected that greenhouse gas emission from data centers will double from 2007 levels by 2020.

One factor of how much greenhouse gas emission a data center is responsible for is the energy efficiency of the data center. One common measure of data center energy efficiency is power usage effectiveness, or "PUE". As discussed further below, PUE is the ratio of the amount of total system (e.g., data center) power to the amount of power used by the electronic (e.g., information technology) equipment of the system. The average data center in the United States has a PUE of 2.0.

SUMMARY

Embodiments of ~~The~~ the present disclosure seek to provide~~s~~ a system~~s~~ for data center cooling and water desalination. In some aspects, the systems include a data center having a water cooling subsystem configured to receive cool water and output warm water and a desalination plant co-located with the data center and configured to receive and desalinate the warm water. ~~Aspects~~ Embodiments of the invention also include a method~~s~~ for cooling a data center using a water cooling subsystem and desalinating water with a desalination plant that is co-located with the data center.

~~Systems~~ According to a first aspect of the present ~~disclosure~~invention, ~~in various instances include~~there is provided a data center having a water cooling subsystem configured to receive cool water and output warm water and a water desalination plant co-located with the data center and configured to receive and desalinate the output warm water. In some embodiments, the cool water ~~is~~ may be received from an ocean or sea. In some embodiments of the systems, the desalination plant ~~is~~ may be a reverse osmosis desalination plant.

In some embodiments, ~~Systems~~ systems may include a water intake. The water intake may~~, in some aspects,~~ be positioned at a depth of 15 m or more in a water source. In some instances, the water intake is positioned below the photic zone in a water source. The systems may also include a water discharge configured for discharging brine from the water desalination

plant. The water discharge ~~is~~may be, in some embodiments, positioned at a depth of 15 m or more in a body of water (e.g., an ocean or sea). In some embodiments, the body of water in which the water discharge ~~is~~ may be positioned ~~is~~ may be the same body of water, e.g., ocean or sea, in which the water intake of a system ~~is~~ may be positioned.

The power usage effectiveness (PUE) of the data center of the disclosed systems~~, in some aspects, is~~ may be 2 or less. In some instances, the PUE of the data center of the disclosed systems ranges from 1 and 1.3. In some instances, the data center and desalination plant of the disclosed systems ~~are~~ may be configured to produce fewer carbon emissions as compared to the same data center and water desalination plant operating independently. In some versions of the systems, the data center and water desalination plant ~~are~~ may be configured to use less energy per amount of data-center cooling and per volume of water desalinated as compared to the same data center and water desalination plant operating independently.

The disclosed systems may include a power plant co-located with a data center and a water desalination plant. In some instances, the power plant ~~is~~ may be operably connected to both of the data center and the water desalination plant. The data center, water desalination plant and power plant may be configured to produce fewer carbon emissions as compared to the same data center, water desalination plant and power plant operating independently. In some versions of the systems, the data center, water desalination plant and power plant ~~are~~ may be configured to use less energy per amount of data-center cooling and per volume of water desalinated as compared to the same data center, water desalination plant and power plant operating independently.

Also provided by the present disclosure are methods for cooling a data center and desalinating salt water. ~~In some instances~~According to a second aspect of the present invention, there is provided ~~the~~ a methods ~~include (1)~~comprising cooling a data center with a water cooling subsystem comprising a cool water intake and a warm water discharge, wherein the water cooling subsystem is configured to absorb heat produced by the data center; and ~~(2)~~ desalinating warm water received from the warm water discharge at a desalination plant that is co-located with the data center. In some instances, the desalination plant ~~is~~ may be a reverse osmosis desalination plant.

In some ~~versions~~ embodiments of the methods, a water cooling subsystem of a data center ~~is~~ may be configured to obtain seawater from a cool water intake. In some instances, a cool water

intake may be positioned below the photic zone of a water source (e.g., below the photic zone of an ocean or sea). The methods may also include discharging brine from the desalination plant into an ocean or sea, e.g., below the photic zone of an ocean or sea.

In some embodiments, the methods for cooling a data center and desalinating salt water using a data center and water desalination plant may produce fewer carbon emissions as compared to the same data center and water desalination plant operating independently. The methods for cooling a data center and desalinating salt water using a data center and water desalination plant may use less energy per amount of data-center cooling and per volume of water desalinated as compared to the same data center and water desalination plant operating independently.

The disclosed methods, in some instances, may also include obtaining power to operate a data center and desalination plant from a power plant co-located with the data center and the desalination plant. In some ~~aspects~~embodiments, the methods for cooling a data center and desalinating salt water using a data center, water desalination plant and power plant may produce fewer carbon emissions than the same data center, water desalination plant and power plant operating independently. In some variations, the methods for cooling a data center and desalinating salt water using a data center, water desalination plant and power plant may use less energy per amount of data-center cooling or per volume of water desalinated than the same data center, water desalination plant and power plant operating independently.

In some embodiments, the methods include maintaining the PUE of a data center at 2 or less. In some instances, the methods may include maintaining the PUE of a data center at a value between 1 and 1.3.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be best understood from the following detailed description when read in conjunction with the accompanying drawings. Included in the drawings are the following figures: