We claim:

1. A thermal energy storage system comprising:

a firebrick layout comprising one or more conductive firebrick layers, each conductive firebrick layer comprising a plurality of electrically conductive semiconductor-doped metal oxide firebricks;

one or more channels to allow airflow through the firebrick layout; and

a first electrode comprising one or more electrode firebrick layers, each electrode firebrick layer comprising a plurality of electrode firebricks, the first electrode configured to receive electrical power from a source;

wherein in response to application of electrical power, the firebrick layout is heated and wherein the one or more conductive firebrick layers are configured such that air flowing through the one or more channels through the firebrick layout is heated.

2. The system of claim 1, further comprising:

a second electrode comprising one or more electrode firebrick layers, each electrode firebrick layer comprising a plurality of electrode firebricks;

wherein the firebrick layout comprises a plurality of electrically isolated layout portions and the first electrode comprises a plurality of electrically isolated electrode portions; and

wherein the second electrode is configured to electrically couple two or more of the electrically isolated layout portions of the firebrick layout to form an electrical transmission path through the firebrick layout.

3. The system of claim 2, wherein each of the plurality of electrically isolated electrode portions is configured to receive an isolated electrical phase from the source.

4. The system of claim 2, wherein the second electrode is configured to provide a neutral point for electrical power provided as 3 -phase power and wherein the thermal energy storage system operates in a wye configuration.

5. The system of claim 1, further comprising one or more insulating layers, the insulating layers comprising one or more insulating firebrick layers, each insulating firebrick layer comprising a plurality of non-conductive firebricks having one or more of the channels for allowing airflow through the insulating firebrick.

6. The system of claim 1, wherein the electrically conductive semiconductor-doped metal oxide firebricks comprise one of: chromium oxide doped with nickel, chromium oxide doped with magnesium, nickel oxide doped with lithium, nickel oxide doped with copper, zinc oxide doped with aluminum, stabilized zirconium oxide doped with cerium, and titanium oxide doped with niobium.

7. The system of claim 6, wherein the electrically conductive semiconductor-doped metal oxide firebricks are doped with a concentration of approximately 102%m3.

8. The system of claim 1, wherein the plurality of electrode firebricks comprises one of: chromium oxide doped with nickel, chromium oxide doped with magnesium, nickel oxide doped with lithium, nickel oxide doped with copper, zinc oxide doped with aluminum, stabilized zirconium oxide doped with cerium, or titanium oxide doped with niobium.

9. The system of claim 8, wherein the electrode firebricks are highly doped with a concentration of approximately 1021/cm3 to be highly conductive and provide low heat generation.

10. The system of claim 5, wherein the non-conductive firebricks comprise one or more of alumina, magnesia, or silica.

11. The system of claim 1, wherein the firebrick layout is heated to a temperature between 1000°C and 2000°C.

12. The system of claim 2, wherein:

the second electrode comprises a plurality of electrically isolated second electrode portions, and

the plurality of electrically isolated layout portions, the plurality of electrically isolated electrode portions, and the plurality of electrically isolated second electrode portions are configured to provide an electrical path through each electrically isolated layout portion.

13. The system of claim 12, wherein a number of snaking portions of each electrical path is an even number for the thermal energy storage system to operate in a 3-phase delta configuration, and wherein the number of snaking portions of each electrical path is an odd number for the thermal energy storage system to operate in a 3-phase wye configuration.

14. The system of claim 8, wherein a dopant mix is approximately 2% to 5%.

15. The system of claim 1, wherein the electrically conductive semiconductor-doped metal oxide firebricks comprise a high temperature metal oxide doped with a metal of a different valency.

16. The system of claim 15, wherein the electrically conductive semiconductor-doped metal oxide firebricks further comprise an electrically inactive oxide.

17. The system of claim 16, wherein the electrically inactive oxide comprises one of alumina, magnesia, or silica.

18. An apparatus, comprising:

a first electrode;

a second electrode; and

electrically conductive firebricks, wherein the electrically conductive firebricks are disposed between the first electrode and the second electrode in a predetermined pattern, each of the electrically conductive firebricks including a semiconductor-doped metal oxide material configured to generate heat based on an electric potential applied between the first electrode and the second electrode.

19. The apparatus of claim 18, wherein:

the predetermined pattern includes a plurality of overlapping layers of the electrically conductive firebricks, and

the electrically conductive firebricks are spaced to form air flow channels.

20. An apparatus, comprising:

a first electrode;

a second electrode; and

electrically conductive firebricks, wherein the electrically conductive firebricks are disposed between the first electrode and the second electrode in a predetermined pattern, each of the electrically conductive firebricks including a semiconductor-doped metal oxide material configured to generate heat based on an electric potential applied between the first electrode and the second electrode, wherein each of the electrically conductive firebricks includes a dopant concentration that corresponds to a temperature of the heat to be generated based on the electric potential applied between the first electrode and the second electrode.