Renewable Hydrogen Plant Based in SOEC Technology

As we all know, for hydrogen production at a competitive cost, it is crucial to influence two factors: **a reduced cost of the electrical energy** of renewable origin that powers the electrolyzer; and a **high number of operating hours per year**, which allows for rapid amortization of said equipment.

The concept described here deals with the integration of **a renewable electrical energy production plant**, a **molten salt energy storage system** and a **high temperature electrolyzer**, so that both objectives are achieved.

Thus, this concept deals with the integration of an electrical energy production plant of renewable origin, which includes an energy storage system in the form of molten salts and a **"solid oxide" type electrolyzer** (called **SOEL** or **SOEC**) for the hydrogen production.

This electrical power generation plant is oversized, and **the excess energy** (that which is not used directly in the solid oxide electrolyzer) is **stored in a molten salt system**.

The molten salt energy storage system is **composed** of an **electric heater**, **pumps**, **tanks**, a **steam generator**, and a **Rankine turbine**.

This molten salt system uses **electrical resistance** to raise the temperature of the salts, and thus store **electrical energy** in the form of **thermal energy**. Then, it is possible to **recover it**, using the thermal energy to produce steam that is used in a turbine that produces (again) electrical energy.

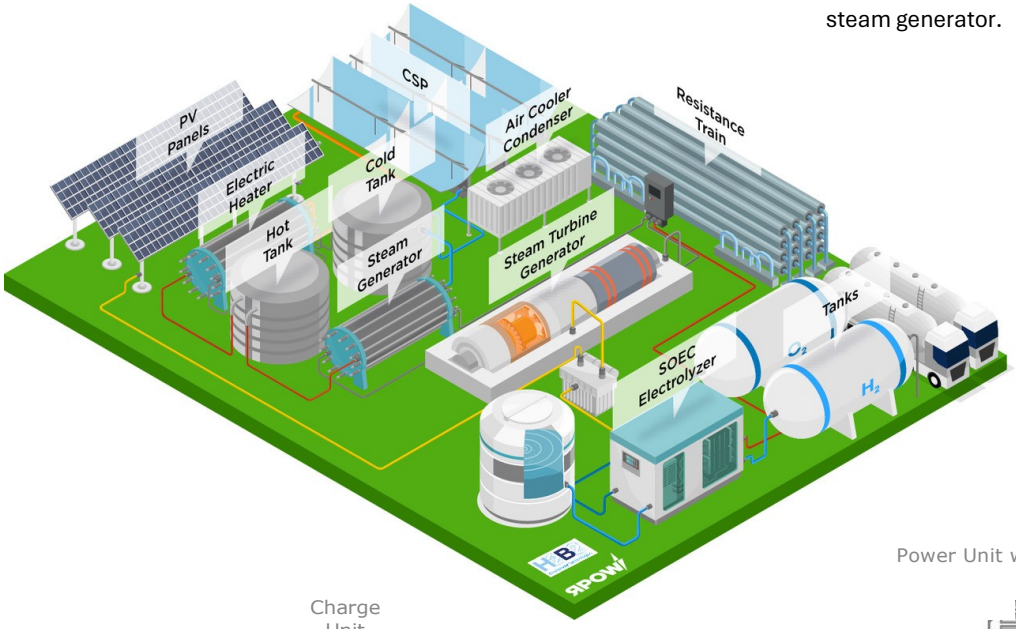
Storing energy in the molten salt system **allows the electrolyzer to be used for more hours** to produce hydrogen, since it does not depend exclusively on the instantaneous renewable resource and energy production can be managed.

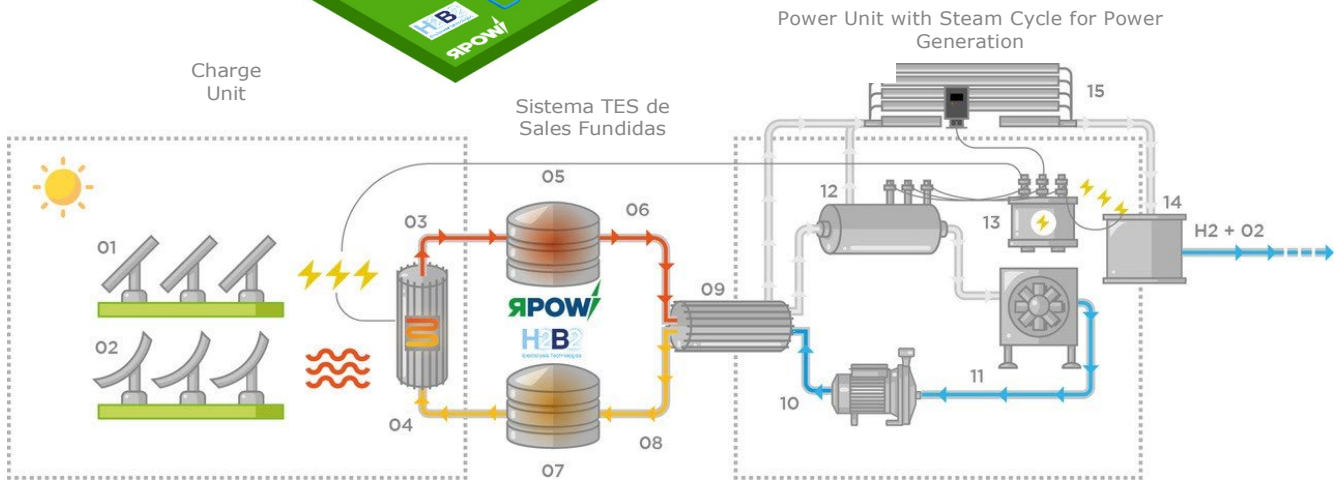
The solid oxide electrolyzer requires, in addition to electricity, the **input of water in the vapor phase** to produce hydrogen. This steam must be at a temperature between 400 and 900 ºC.

The **molten salt energy storage system** is used to **heat water** and convert it into **steam**, to produce electrical energy through a steam turbine. During the night, the steam feed to the solid oxide electrolyzer is obtained by means of steam extractions in the steam turbine. During the day, steam is taken from the steam generator which is pressurized.

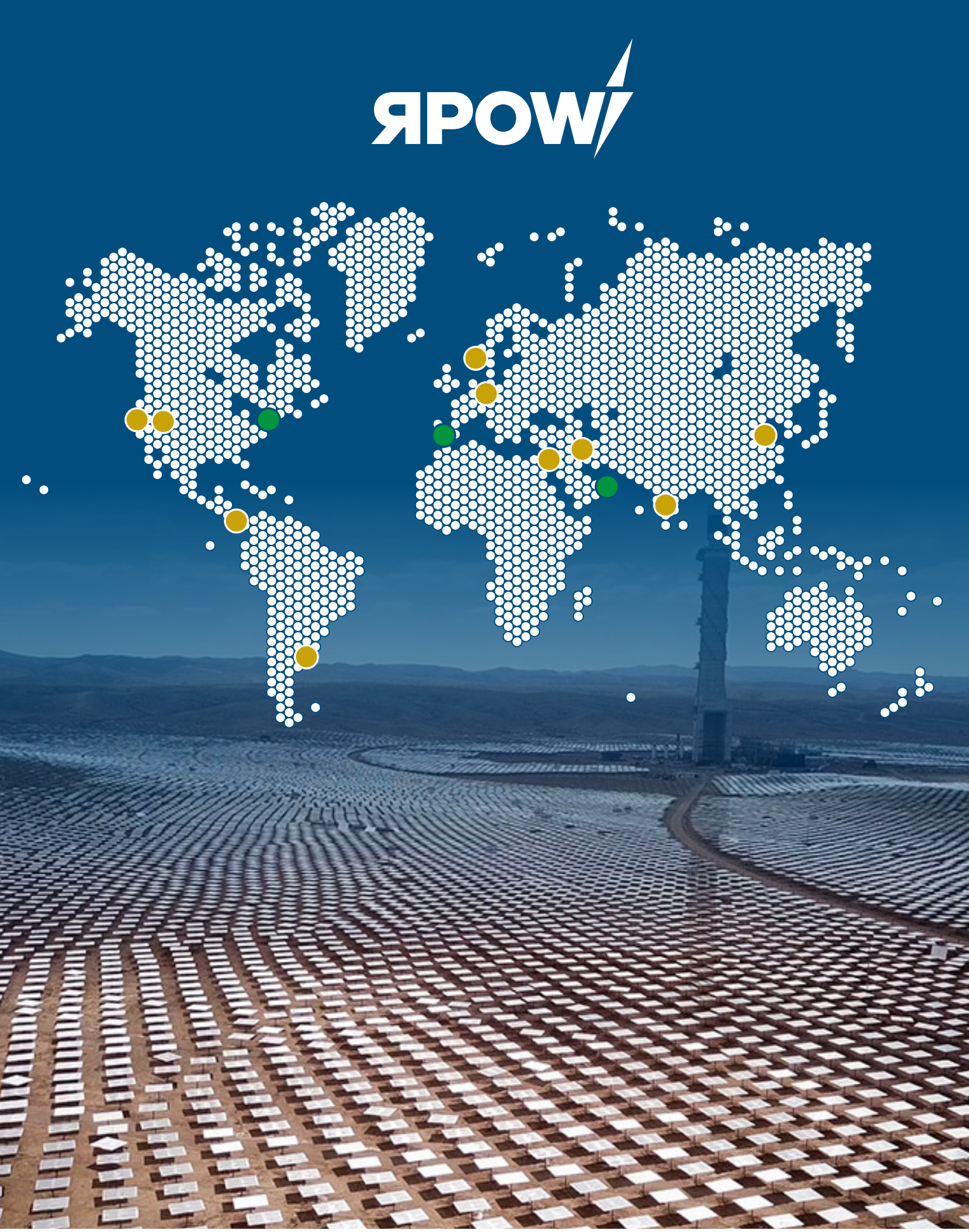
As can be seen, **the steam delivered to the SOEC** electrolyzer comes during the **night** (turbine in operation) from one of the steam turbine extractions and during the **day** it comes directly from the steam generator.

Precisely, **the most innovative part is the integration of the three elements**, so that the molten salt energy storage system is used to store electrical energy (which powers the electrolyzer when the renewable electrical energy generation plant does not produce it) and superheated steam that is used in the high temperature electrolyzer for the production of hydrogen. This maximizes hydrogen production, since it increases the number of hours of operation of the electrolyzer and feeds it water into steam, reducing the electrical consumption of electrolysis.





01. PV
02. CSP field
03. Electric heater
04. Molten salt heat exchanger
05. Hot molten salts tank
06. Hot molten salt
07. Cold molten Salts tank
08. Cold molten salt
09. Steam generator
10. Water at the pump outlet
11. Water at the condenser outlet
12. Turbine/Generator
13. Transformer
14. SOEC electrolyzer
15. Electric resistance train



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