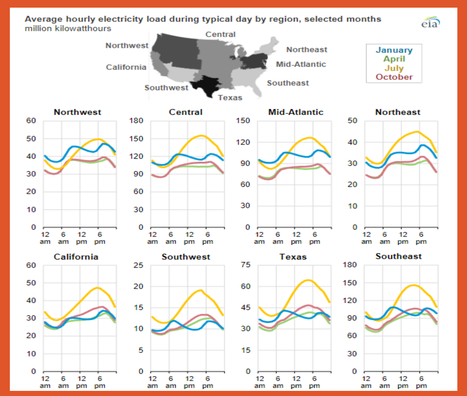
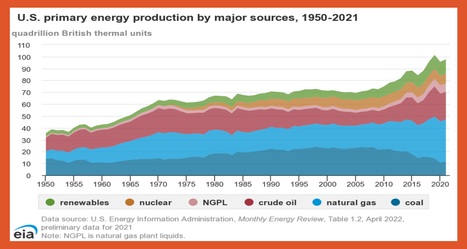
POWER DEMAND

- Power demand across the country fluctuates with the time of the day and the season.
- Nuclear power plants have long and expensive startup/shutdown procedures. In effect, nuclear power plants cannot shutdown during times of lower electricity demand, leading to wasted energy and money.
- Hydrogen is a promising fuel for the future. The majority of hydrogen gas produced utilizes steam reformation, a method of producing hydrogen, which uses methane to split water into oxygen and hydrogen gas. Nuclear power could provide the energy necessary to produce hydrogen without methane being necessary, producing "pink" hydrogen, the term for hydrogen produced using nuclear energy.
- By diverting excess energy from nuclear reactors during times of low grid demand to produce hydrogen, the otherwise wasted energy could be used to generate storable hydrogen gas.



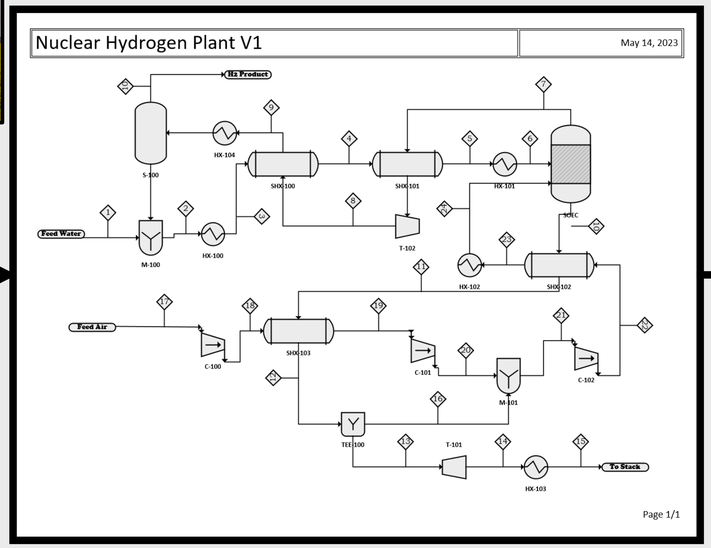


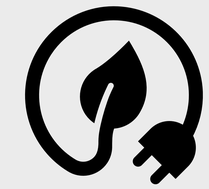
Oregon State University

NUCLEAR HYDROGEN

TEAM MEMBERS: LUKE WIEBE, EVAN DAVIS, SEBASTIAN VAUGHAN

Utilizing nuclear power during times of low grid demand to generate carbon-neutral H_2 gas via high temperature steam electrolysis (HTSE).





IMPLEMENTATION

The above figure displays a purposed plant design

Implementation and Costing:

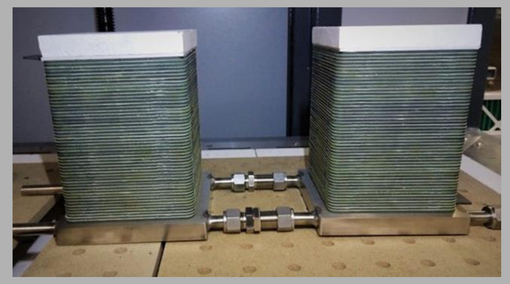
- The national goal set by the DOE for H2 as a fuel source is < $2 per kg.
- According to Idaho National Laboratory, a fully optimized HTSE can produce pure H2 gas at $1.86 per kg.
- A fully optimized HSTE process incorporates a network of heat exchangers and turbines to capture and recycle process heat.
- The core of the design consists of the steam boiler, using NPP as the input, a series of SOEC's to carry out the HSTE, an H2 purification process, and an air sweep and recycling process..

HTSE AND NUCLEAR ENERGY

- High temperature steam electrolysis (HTSE) utilizes high temperature steam in conjunction with solid oxide electrolysis to achieve high throughput carbon-free hydrogen production demands.
- However, with the coupling of the HTSE process with next-generation nuclear reactors:
  - Further reduces the independent energy demands the process has on the grid to achieve the desired phase and energy intensive transformations.
  - Allows a hydrogen production facility to operate completely self-reliantly while meeting production demands efficiently.
  - Be able to more aptly produce said hydrogen while minimizing any straining effects a non-nuclear-powered plant might have on a nearby power grid.

SOLID OXIDE ELECTROLYSIS CELLS

- Solid oxide electrolyzer cells, or SOEC's, are regenerative fuel cells that consume electricity and a constituent chemical to produce a desired chemical product.
- Put from a design standpoint, SOEC's consist of a fuel electrode (cathode), an oxygen electrode (anode) and a solid-oxide electrolyte and are the basis upon which HTSE is capable of sustainably and efficiently producing hydrogen gas to meet modern energy and production demands.



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